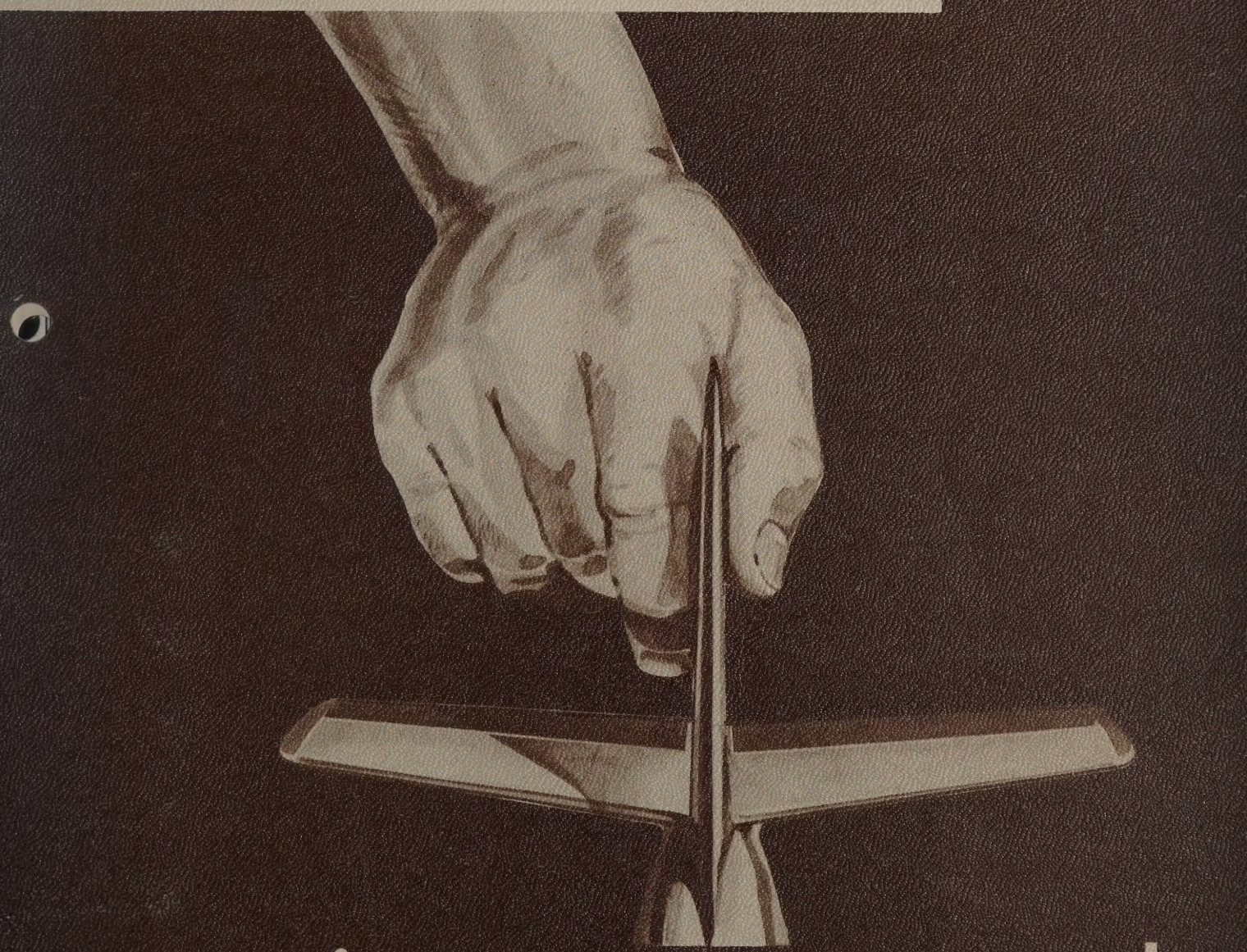
LEAR ARCON

automatic rudder control



maintenance manual

LEAR, INC.
LEARCAL DIVISION

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MAINTENANCE MANUAL

for the

LEAR ARCON

AUTOMATIC RUDDER CONTROL

LEAR, INC., *LEARCAL DIVISION*

3171 S. BUNDY DRIVE, SANTA MONICA, CALIFORNIA, U. S. A.

TM 18

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Model 5452 Controller Installation Drawing

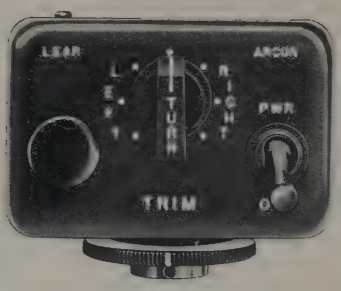
702340 Model 977L Rate Gyro Installation Drawing

Model 2219 Amplifier Installation Drawing

Model 3000 Motor-Alternator and Servo Installation Drawing

702388 ARCON Model 1-A Interconnection Diagram

1.



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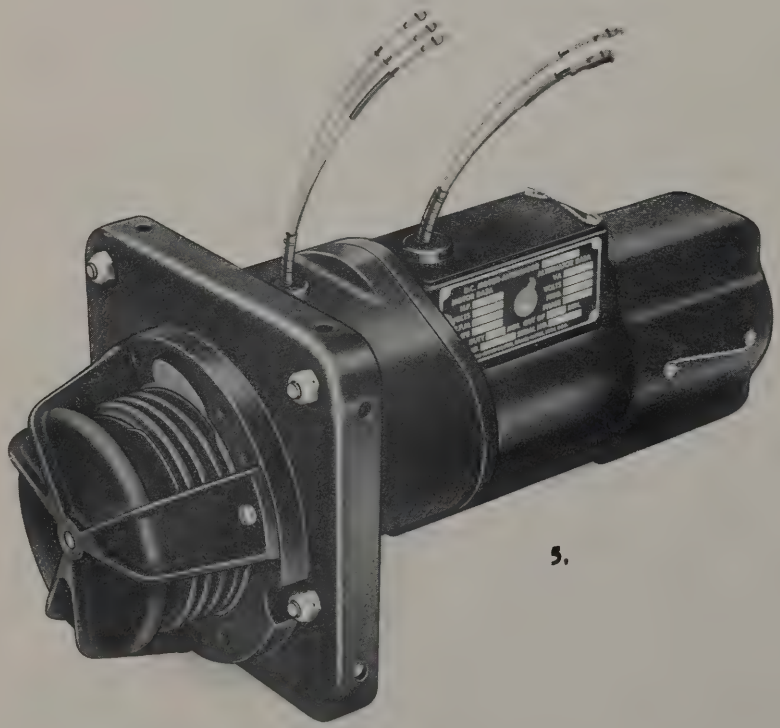


5.

1. Engage—Disengage Switch No. 702830-02
2. Controller Model 5452
3. Amplifier Model 2219
4. Rate Gyro Model 977L
5. Motor-Alternator Model 3000

Figure 1-1. Components of the Lear ARCON Model 1-A

SECTION I

FUNCTION AND DESCRIPTION

1. What the ARCON Does

The Lear ARCON is primarily a safety device which prevents unintentional spiral dives due to pilot error occurring under instrument flight conditions.

The ARCON accomplishes its purpose by automatically controlling the aircraft rudder in such a way as to arrest yaws in excess of a given rate of turn. This rate varies in different aircraft, but, generally, it can be said that the ARCON arrests yaws in excess of about 15° per minute.

The ARCON is superior to many other automatic rudder control types since it reacts faster and a great deal more smoothly than straight mechanical types.

2. Description of Components

The components of the ARCON Model 1-A are shown in Figure 1-1.

a. Engage - Disengage Switch

The Engage-Disengage Switch is an ordinary two-pole, single-throw switch of the push-on, pull-off type. It mounts, together with its instruction plate, on the pilot's control wheel.

b. Controller Unit

The Controller mounts the power switch, and the turn and trim controls. The Power switch is a toggle type two pole single throw which is located in the primary power input line to the ARCON. The turn and trim controls are respectively, a potentiometer and a rheostat. The controller measures 3-1/8" by 2-3/8" by 2-1/2" and is mounted on the aircraft instrument panel or at some other point convenient to the pilot.

c. Rate Gyro

The ARCON rate gyro consists of a torsion bar mounted gyro together with an EI laminated pickoff, both of which are contained in a hermetically sealed container. The gyro is mounted at the center point of the main wing spar or at some other point on the fore-and-aft center-line of the aircraft.

d. Amplifier Unit

The amplifier unit is mounted at any convenient point in the aircraft. It contains the circuit elements necessary to convert the low level ac output of the gyro into a useable d-c current for the operation of the magnetic clutches in the rudder control servo.

e. Motor-Alternator-Servo

The motor-alternator consists of a d-c motor, operating at a no-load speed between 7,000 and 8,000 rpm, coupled to an alternator which produces 110 volts at 14.7VA three phase output. This a-c is used to operate the gyro motor, to provide a gyro output signal as well as to operate the amplifier unit.

The motor is also employed to drive the rudder cable capstan through two magnetic clutches, a mechanical clutch, and appropriate gearing. The magnetic clutches allow two-directional rotation of the capstan by the one direction rotation of the motor. In addition to the magnetic clutch, a mechanical slip clutch is employed as a means of controlling maximum torque applied at the rudder cables, and to enable the pilot to over-ride the ARCON control mechanism when he so desires.

3. Technical Characteristics

Weight and Over-all Dimensions (Approximate, excluding cabling and special mounting fittings)

Engage-Disengage Switch (1-1/2" x 5/8" x 1-1/2")	.2 lbs
Controller (3-1/8" x 2-3/8" x 2-1/2")	.5 lbs
Rate Gyro (4-1/2" x 2-9/16")	1.2 lbs
Amplifier Unit (9-3/4" x 4-1/2" x 3")	2.7 lbs
Motor Alternator (11-3/4" x 5" x 5")	7.4 lbs
Total Weight	12.0 lbs (excluding cabling)

Control Capability:

Gyro Sensitivity	Detects rate of turn of 6° per minute or faster
System Sensitivity (actual practical operating sensitivity depends upon specific aircraft)	Approximately 15° per minute
Maximum Corrective Torque Capability (This figure is a maximum. In most aircraft the output torque is established at a much lower level by setting the mechanical clutch at the CAA required level)	220 in. lbs

Operating Power Requirements:

Primary Power	14 vdc (Model 1A-1) 28 vdc (Model 1A-2)

Current Drain:
(Maximum torque). . . . . 6 amps (at 14 vdc)
3.1 amps (at 28 vdc)

4. Reference Data

a. Manufacturer's Data

The ARCON is manufactured by Lear, Inc., LearCal Division, 3171 S. Bundy Drive, Santa Monica, California, U.S.A. Direct all inquiries to the attention of the Sales Department at the above address.

b. Equipment Required

The following equipment is required for the completion of an ARCON Model 1-A installation:

TABLE I. LEAR ARCON EQUIPMENT LIST

Quan.	Item	Model or Part Number
1	Amplifier Unit	
	14 volt	Model 2219A
	28 volt	Model 2219B
1	Motor Alternator	
	14 volt	Model 3000C
	28 volt	Model 3000D
1	Engage-Disengage Switch	No. 702830-02
1	Controller	Model 5452A
1	Rate Gyro	Model 977L
1	Installation Kit	
	Piper Pacer	No. 703979
	Beech Bonanza	No. 703088
	Cessna 170	No. 703437-01
	Cessna 180	No. 703437-02
	Navion	No. 703767

SECTION II

THEORY OF OPERATION

1. General

The Lear ARCON consists, basically, of a rate gyro, a Detector-Amplifier, and a Servo Mechanism. The rate gyro detects motion of the aircraft in the yaw axis and produces an output signal. The Detector-Amplifier detects and amplifies the signal to produce a useable signal for the operation of the servomechanism. A thumbnail sketch of the ARCON operational sequence is given in Figure 2-2.

2. The Rate Gyro

a. What the Rate Gyro Does

When the human pilot controls the aircraft in the yaw axis, he does so by reference to the ground or compass with his eyes, and by reference to gravity and centrifugal force through his sensory nerves and balance canals. Under instrument flight conditions, the inexperienced human pilot may try to continue the use of his sensory nerves and balance canals to maintain a level flight attitude. When this occurs, the pilot is very likely to inadvertently enter a co-ordinated turn and, from there, a co-ordinated spiral dive. The ARCON prevents the spiral dive (or graveyard spiral) which is one of the leading causes of death in IFR flight.

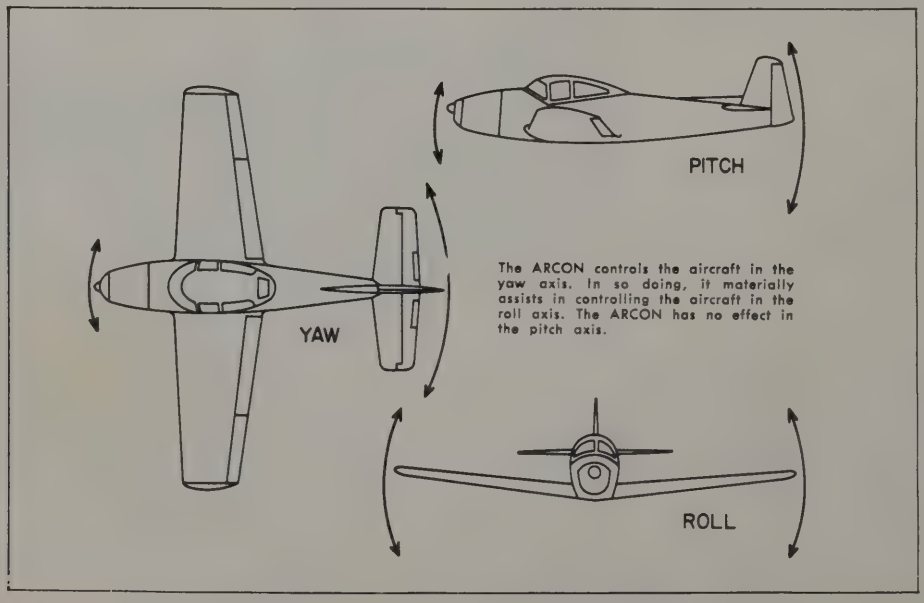
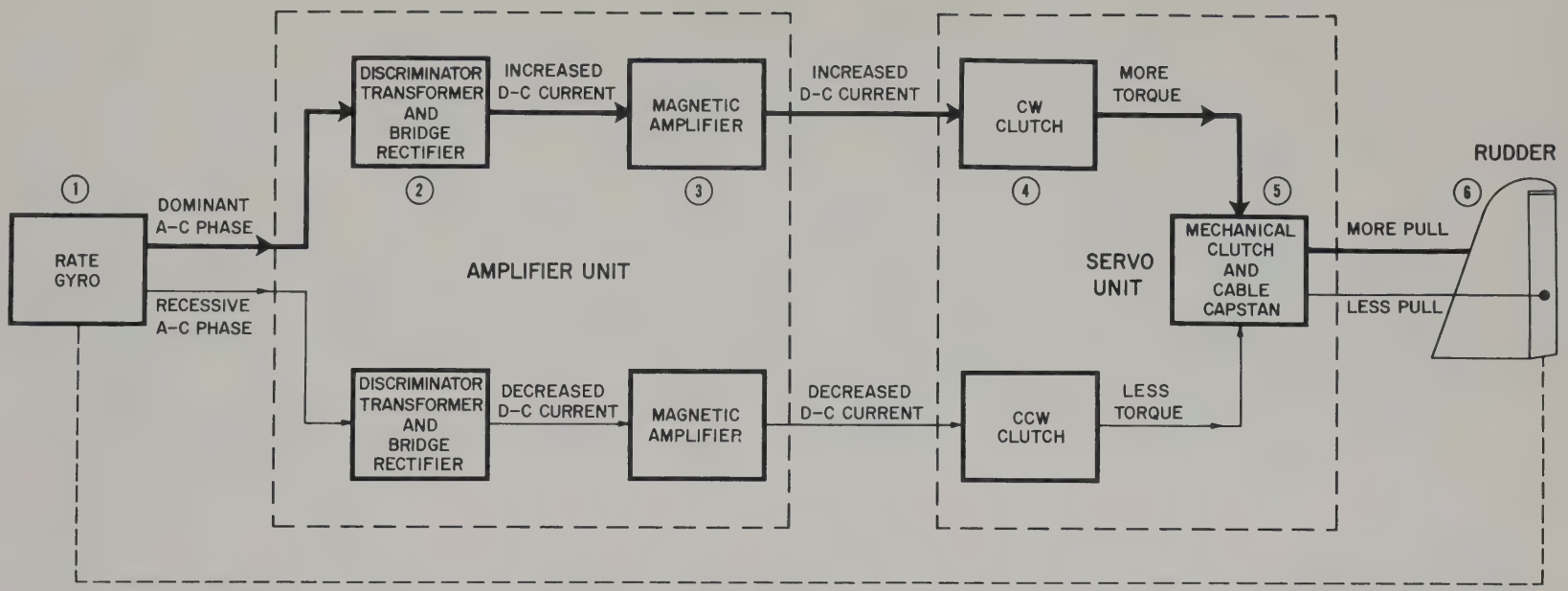

PITCH
YAW
ROLL
The ARCON controls the aircraft in the yaw axis. In so doing, it materially assists in controlling the aircraft in the roll axis. The ARCON has no effect in the pitch axis.

Figure 2-1. The Three Axes of Flight



1. WHEN THE AIRCRAFT YAWS, THE GYRO PRODUCES AN ERROR SIGNAL

2. TWO BRIDGE RECTIFIERS WHICH NORMALLY CONDUCT THE SAME AMOUNT OF CURRENT CONDUCT DIFFERENT CURRENTS. ONE CONDUCTS MORE CURRENT, THE OTHER LESS CURRENT THAN IN THE REST POSITION

3. MAGNETIC AMPLIFIERS AMPLIFY THE DIFFERENTIAL OUTPUT OF THE BRIDGE RECTIFIERS

4. ONE MAGNETIC CLUTCH DEVELOPS MORE TORQE THAN THE OTHER

5. THE CAPSTAN IS ROTATED IN THE PROPER DIRECTION TO CAUSE THE RUDDER TO ARREST THE YAW MOTION

6. WHEN THE RUDDER ARRESTS THE YAW, THE GYRO IS "SATISFIED" AND THE SYSTEM IS ONCE MORE IN BALANCE

Figure 2-2. How the ARCON Corrects for Aircraft Yaw

When the ARCON takes control of the aircraft rudder, the Rate Gyro takes the place of the human pilot's senses. The Rate Gyro is superior to the human pilot because it senses a change of direction in the yaw axis whether that change is coordinated with a change in roll axis or not. The Rate Gyro is exactly what its name implies. It detects a rate of turn and, through the ARCON system, causes the turn to be arrested. The rate gyro has no compass directional reference, and thus is of little use in holding a heading indefinitely, though it will materially assist in aiding the pilot to hold his plane on course.

b. How the Rate Gyro Operates

The rate gyro operates on the principle that the inertia of a spinning wheel resists any tendency toward motion in its spin axis. Figure 2-3 is a simplified diagram of the ARCON rate gyro. The pivots of the gyro are located at points A and B. When the aircraft yaws, the gyro "precesses" since the pivots are fixed to the airframe and the spinning wheel is forced by its moment of inertia to move in a direction that is 90° from the applied force. This up and down motion of the spin axis is called "precession" and is detected as a Left or Right signal which is transmitted to the ARCON system.

Note that the gyro frame is torsionally mounted by springs at either side. These springs return the gyro to its center (rest) position after a turn has been made so that the system may immediately detect the next yaw motion of the aircraft. Because of the spring return mechanism, the aircraft must yaw at a given rate in order to overcome the spring tension. Any yaw rate over 6° per minute will overcome the spring tension and result in a perceptible turn signal being transmitted through the ARCON system. Whether this "threshold" signal will cause a corrective action or not, is dependent upon other factors which have nothing to do with the rate gyro. Threshold operation will vary between aircraft, and even in the same aircraft under different flight conditions.

c. The Gyro Pickoff

Figure 2-4 shows the "E-I" pickoff used to detect yaw motions of the aircraft relative to the spin axis of the rate gyro. The name ("E-I") of the pickoff is derived from its physical form.

The stator of the pickoff (the "E" lamination) is fixed to the airframe. The rotor of the pickoff (the "I" lamination) is connected, at its center, to the gimbal post of the rate gyro. An excitation voltage of 71V, 400 cps is applied at the center leg of the stator. This applied voltage at the center leg induces a voltage in each of the outer legs of the E. Note that the windings at the outer legs of the E are connected series opposing with the output load. This connection causes the voltage induced in the two outer legs to be 180° out of phase.

In the rest position (no yaw of the aircraft) the ends of the I element in the pickoff are equidistant from the legs of the E element. In this condition, the voltages induced in the legs of the E element are equal and of opposite phase and thus cancel each other across their output load, the RG Gain potentiometer.

As soon as the aircraft yaws at a rate great enough to overcome the spring torsion of the rate gyro, the gyro precesses and the I element is moved with respect to the E. Depending upon the direction of yaw, one of the ends of the I element of the pickoff moves more closely to its leg in the E element, while the other end of the I moves further away from its leg in the E element.

The result of this movement is to change the reluctance of the magnetic paths in the legs of the

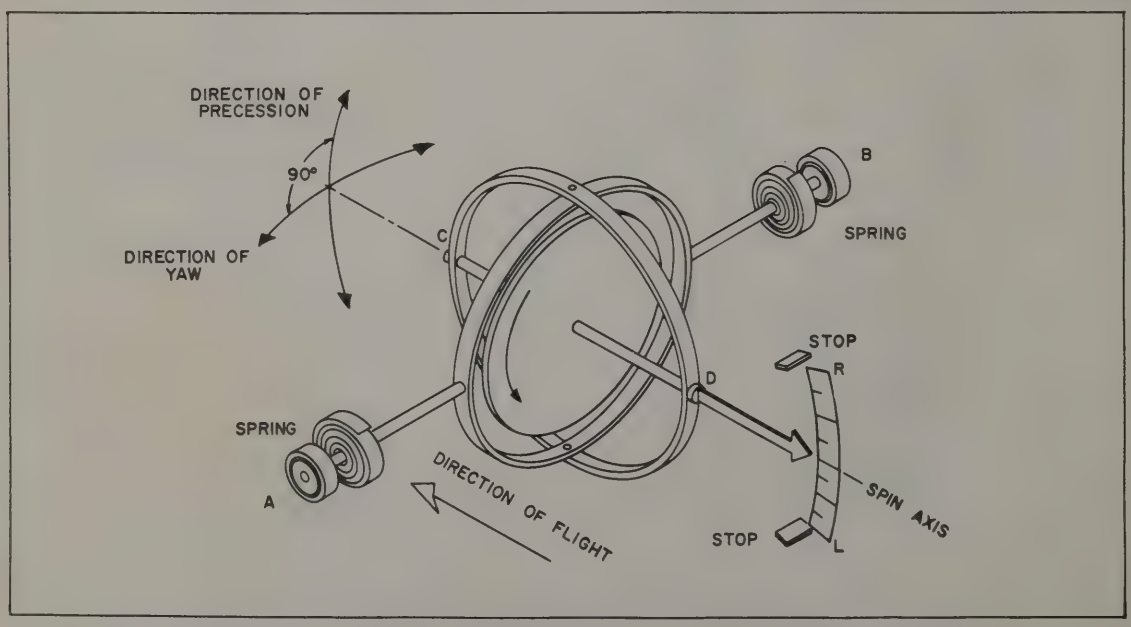


Figure 2-3. The ARCON Rate Gyro, Simplified Drawing

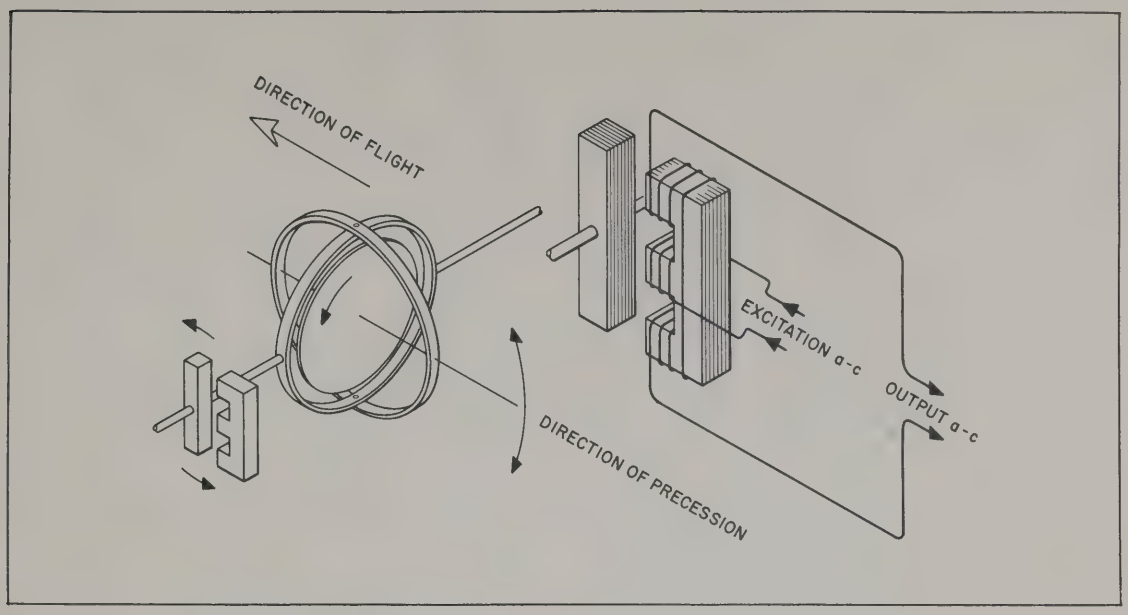


Figure 2-4. The Rate Gyro Pickoff

E. In the coil with the decreased airgap the reluctance (and thus the output voltage) is increased. In the coil with the larger airgap the reluctance and the output voltage are reduced. It will be recalled that the two windings in the E produce their output 180° out of phase. The result, then of a movement of the I with respect to the E is to increase the gyro output in one phase, while it decreases the output in the second phase.

This output, stronger in one phase than in the other, is the error signal output of the rate gyro, and creates the electrical unbalance necessary to cause the system to make the rudder corrective movement which arrests the aircraft yaw.

3. Amplifier Unit

a. What the Amplifier Unit Does

The amplifier unit rectifies and amplifies the error signal produced by the rate gyro, to enable the servomechanism to take corrective action based upon the information derived by the gyro.

b. How the Amplifier Unit Operates

Two different kinds of information are delivered to the amplifier unit from the rate gyro; voltage information and phase information.

(1) The magnitude of the gyro error signal is determined by the rate of yaw. The greater the rate of yaw, the greater the voltage of the error signal.

(2) The phase is determined by the direction in which the aircraft yaw takes place.

Figure 2-5 shows the sequence of operation followed in the rate gyro and amplifier unit in making a correction for right yaw.

When the aircraft yaws to the right the "I" lamination moves with respect to the "E" lamination, and an output voltage is delivered from the rate gyro to the secondary of discriminator transformer, T1. The reference voltage is fed to the primary of T1.

With the rate gyro in the rest position, the output from the two legs of the E element of the pickoff are equal in amplitude and opposite in phase. The outputs therefore cancel and cause BR1 and BR2 to conduct equally thus balancing the system.

As soon as an error signal is introduced, however, the balanced relationship of BR1 and BR2 is destroyed. The secondary of T1 is center-tapped. Because of the center-tap, the voltage between terminals 5 and 6 is 180° out of phase with that between terminals 4 and 6. The increased voltage from the pickoff in the error condition will be in phase with one side of the T1 center tap output and out of phase with the other side. The same is true of the decreased voltage derived from the pickoff.

In Figure 2-5, the error output from the rate gyro adds with the T1 signal between terminals 5 and 6 of T1 and BR1 begins to conduct more current while BR2 conducts less current. If the yaw were to the left, the opposite would be true. The differential, in the outputs of BR1 and BR2 is amplified and, as will be demonstrated, is used to produce the differential currents necessary to operate the ARCON servo system.

4. The Magnetic Amplifier Circuit

To properly understand the method in which the rectified current in BR1 and BR2 produce the current necessary for the operation of the magnetic clutches, it is necessary to first understand the operation of the magnetic amplifier which delivers the clutch operating current.

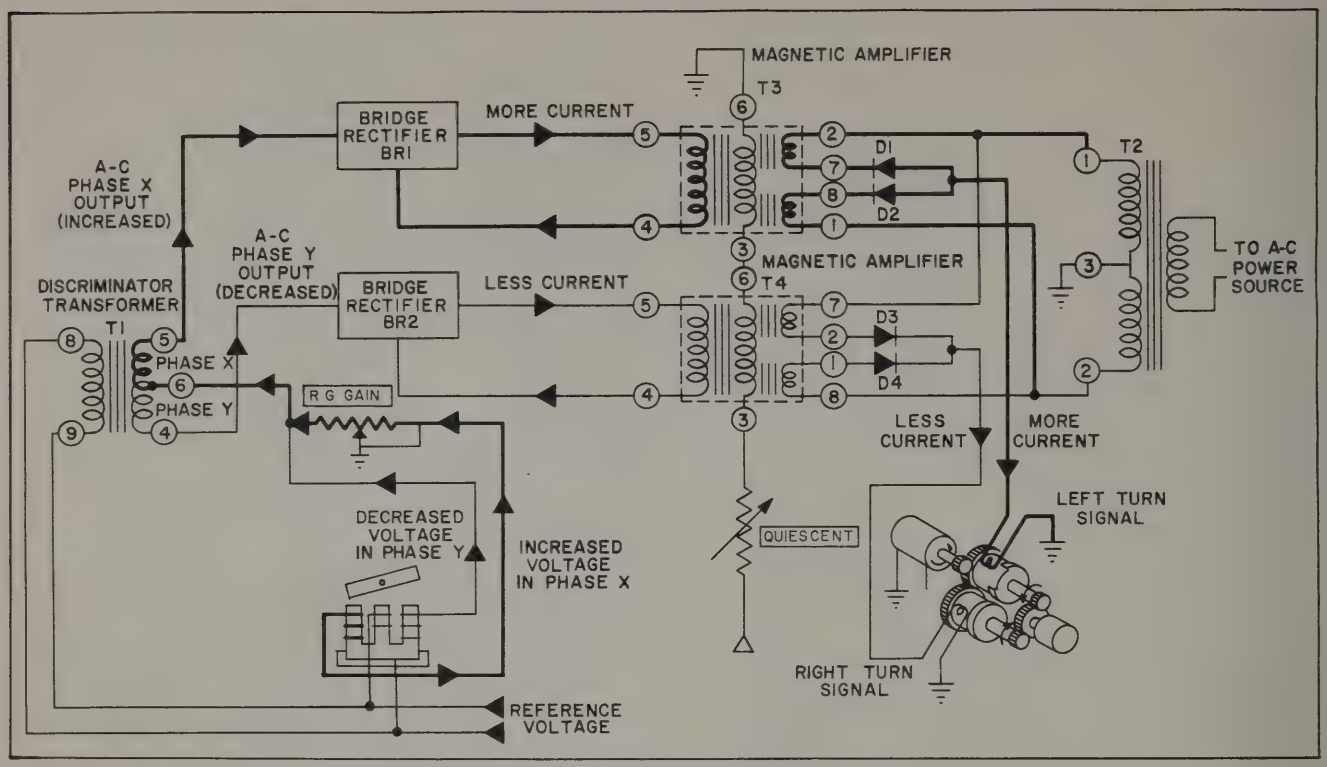


Figure 2-5. ARCON System Block Diagram

a. Reactance

In a magnetic amplifier, control of output is achieved by electrically varying the amount of reactance produced by a pulsating d-c current flowing in an inductor.

The reactance of a coil is proportional to its inductance as long as the core of the coil is not saturated. Upon saturation of the core, however, the reactance of the coil decreases to a small value.

The degree of saturation of the core of an inductor is determined by the flux density of the core.

Figure 2-6A illustrates an inductor through which a d-c current is flowing. The core of the coil is polarized (North-South) in accordance with the direction of current flow through the coil. If the direction of current flow is reversed, the magnetic poles of the coil core would also be reversed.

The magnetic characteristics of the core are the result of flux lines in the core produced by the flow of d-c current. The more current, the greater the flux line density. There is a point when a greater flow of current will produce no appreciable increase in flux density. At this point the core of the coil is said to be "saturated".

The formation of the flux pattern in the core of an inductor has a definite relationship to the reactance of the inductor.

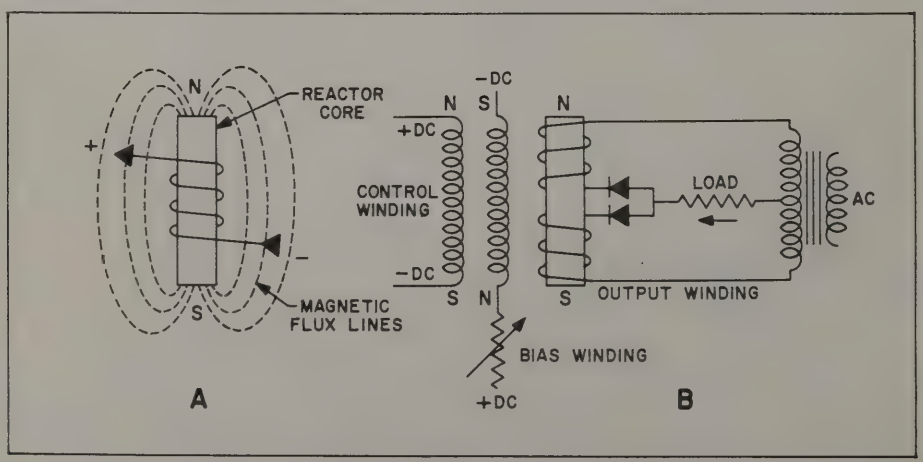


Figure 2-6. Magnetic Amplifier Simplified Schematic Diagram

Consider the instant when a d-c circuit including an inductor is first closed. At first there is little current flow because the "back electro-motive force" (back emf) of the inductor tends to prevent current flow. But back emf is produced by current change affecting the flux density characteristics of the inductor. As soon as the current stabilizes, no further back emf is created.

This instantaneous effect in a d-c circuit when power is first applied illustrates reactance.

Reactance is the impedance to current flow created by current change through an inductor.

Now consider the case of a pulsating d-c current being applied to an inductor having a high saturation point. The pulsating d-c will be continually erecting, then collapsing, the magnetic flux in the core of the inductor. The reactance, therefore, will be great.

If, on the other hand, an inductor with a low saturation point is considered, it will be found to have very little reactance. As the pulsating d-c is applied, the magnetic field of the inductor core will almost immediately stabilize and thus the increasing curve of the current pulse will create negligible back emf. The result: less impedance (thus greater current flow) than is true in the case of the inductor with a high saturation point.

b. Control of Reactance

Refer to Figure 2-6B. Two windings have been added to the simple inductor of Figure 2-6A. The three windings are titled as follows:

(1) The Output Winding. This winding delivers the output to the load. The output is in the form of a full-wave rectified d-c. An a-c source is connected across the output winding through two half-wave rectifiers. The winding to one rectifier is opposite that to the other rectifier so that current flow from both positive-going and negative-going impulses flows in the direction tending to produce the magnetic polar relationships shown in the diagram.

(2) The Bias Winding. A steady d-c current flows through the bias winding. It is wound in such a way that, were current to flow through it alone, magnetic poles opposite those produced by the output winding current would be created in the inductor core.

(3) The Control Winding. Current flow in the control winding produces a flux pattern in agreement with that produced by the output winding, but opposing that produced by the bias winding. Current flow variations in the control winding produce corresponding current variations in the output winding.

This is how the reactance of the magnetic amplifier is varied in order to control the flow of current through the output winding to the circuit load:

Without a control or bias signal, current flow in the output winding meets very little impedance since the magnetic amplifier is purposely designed with a core having a very low saturation point.

When current flows through the bias winding, however, the impedance to current flow in the output winding becomes greater because each d-c pulse in the output winding must not only erect a flux density pattern in agreement with its flow direction, but it must also collapse the opposing flux density pattern created by the flow of bias current.

Two conditions have thus far been described. Maximum output when the current in the output winding saturates the amplifier. Minimum output when the applied bias current effectively raises the saturation point of the amplifier and thus the reactance and impedance to current flow in the output winding.

The third condition is any point between these two extremes dictated by the flow of current in the control winding. Increased current through the control winding causes the reactance in the output winding to be decreased, while decreased current flow through the control winding allows the bias current to take increased effect, thus causing a decreased current flow through the output winding.

In the ARCON a small amount of current flows through the control windings of T3 and T4 at all times. Bias current is adjusted against this current to produce a "quiescent" (rest) current in the output winding of 15 ma. Changes in output occur from this center as a result of differential conduction of BR1 and BR2 as described in paragraphs 2 and 3.

5. The Servomechanism

The correction signal delivered to the Servomechanism from the Amplifier Unit is current that is derived in the manner described in paragraphs 2 through 4, above. The output is not used to operate a motor directly, but varies the torque in two magnetic clutches which couple the rudder cable capstan to a constantly operating motor.

The interior of a typical magnetic clutch is shown in Figure 2-7. The output shaft (labelled "driven shaft"

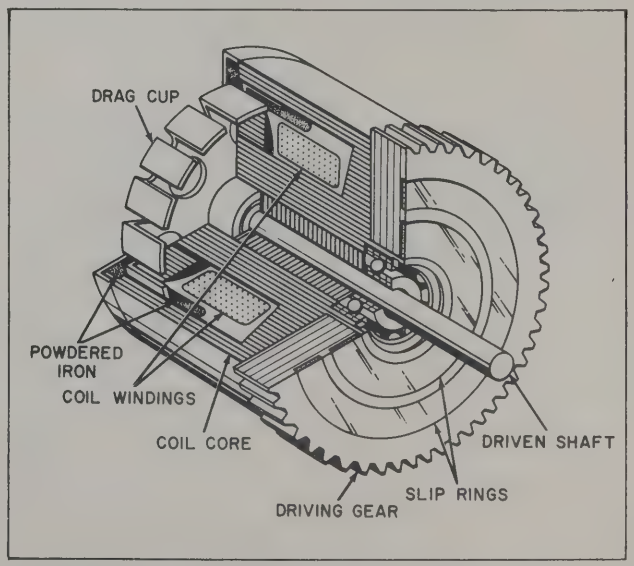


Figure 2-7. Magnetic Clutch, Sectional View

in the figure) is connected to a drag cup. Under no current conditions the drag cup is free in the reservoir of magnetic filings, and the clutch body rotates without causing motion of the output shaft. As soon as current flows through the coil, however, a magnetic field is induced which stiffens the iron filing reservoir and causes the drag cup (thus the output shaft) to rotate with the clutch body. The torque produced by the clutch is a function of the amount of current that flows through the excitation winding. The more current, the more torque produced. Within certain limitations, this relationship is linear.

When the system is at rest, a quiescent current of about 15 ma is applied to both clutches. As soon as an error signal is developed in the rate gyro, however, more current is delivered to one clutch than to the other (see paragraphs 2 through 4, above). Since the clutches are linear, the clutch having a greater amount of current fed to it will produce more torque proportionate to the increment above 15 ma. Similarly, the clutch having less current delivered to it will produce less torque. The result: rotation in the direction dictated by the clutch producing the most torque and consequent corrective action by the rudder to arrest the yaw motion. Since the reaction is a matter of change, rather than "on, off", the ARCON controls the rudder smoothly and rapidly without the "chopping" action of straight mechanical systems.

6. Summary of Operation (Refer to Figure 2-5)

To sum up ARCON operation:

a. The aircraft yaws to the right.

b. The rate gyro precesses, thus moving the "I" laminate with respect to the "E" laminate.

In the illustration, the left leg of the "E" is closest to the "I", thus increasing the reluctance and the output of that leg, while decreasing the reluctance and the output of the right, "away" leg.

c. Because of the change in reluctance, the output of the left leg, in phase with the signal between terminals 5 and 6 of T1, increases from the "rest" level. The output of the right leg of the E, in phase with the signal between terminals 4 and 6, decreases from the "rest" level.

d. As a result of the gyro action, Rectifier BR1 conducts more current through the control winding of T3, while rectifier BR2 conducts less current through the control winding of T4.

e. The changes in control current flow at T3 and T4 result in the bias at T3 being overcome to a greater extent than in the "rest" condition, while the bias at T4 becomes more effective than in the "rest" condition.

f. As a result of the magnetic amplifier action, D1 and D2 are allowed to conduct more current, while D3 and D4 conduct less.

g. With the disturbance of the Quiescent (balanced) condition, by the application of different currents from T3 and T4, the clutch which causes left rudder motion develops increased torque proportionate with the increased current, while the clutch that causes right rudder motion develops less torque.

h. The result of this torque differential is to cause the rudder cable capstan to rotate in the direction necessary to apply left rudder.

i. Left rudder is continuously applied until the yaw is arrested and the system once more returns to the rest condition.

7. The Discriminator Transformer and Turn Control

The function of Discriminator Transformer T1 relative to rate gyro signals is fully explained in sub-paragraph 3a, above. In addition to the secondary comprising terminals 4, 5, and 6, T1 has another secondary winding comprising terminals 2, 7, and 3. This secondary is used to provide a reference signal to the ARCON Controller for the purpose of TURN, and TRIM control operation.

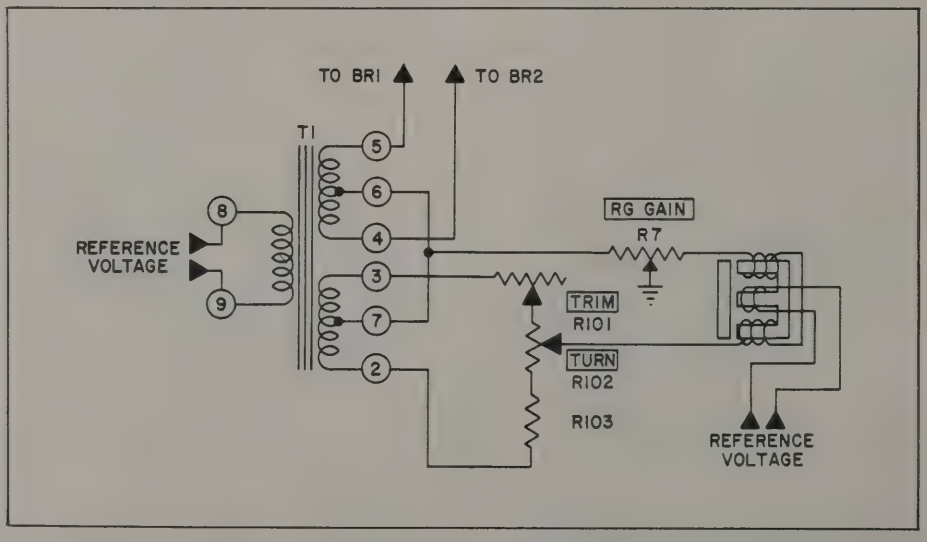


Figure 2-8. TURN and TRIM Controls, Simplified Schematic Diagram

Figure 2-8 is a simplified schematic drawing showing the connections to the TURN and TRIM controls from the rate gyro and discriminator transformer.

TRIM control R101, and TURN control R102 are in series across the terminal 3, 7, 2 secondary of T1. The arm of R102 is connected to a leg of the E laminate in the gyro pick-off. The two resistances vary the amount of a-c voltage from T1 which is placed in series with the pickoff voltage. In so doing, R101 and R102 effectively control the phase dominance of the gyro output signal and thus the output of BR1 and BR2. Since the TURN and TRIM controls are in series with the rate gyro pickoff, the rate gyro signal still has an effect when a turn is being executed through the use of the TURN control. This feature allows the gyro to control the rate of turn and, to some extent, the degree of bank, when a turn is executed with the ARCON.

SECTION III

MAINTENANCE PROCEDURES

1. Test and Maintenance Equipment Required

The following equipment is required for the proper testing and maintenance of the ARCON system:

Figure 3-1. ARCON Test Set
Figure 3-2. ARCON Gyro Substitution Test Set

TABLE 3-1. ARCON TEST AND MAINTENANCE EQUIPMENT

Manufacturer and Part No. or Model	Name	Description
Lear Model 2243	ARCON Test Set	This set provides a means of making initial adjustments at the time the ARCON is installed. It also allows rapid system trouble localization to be performed since it readily provides a means for checking the following system characteristics: Right Clutch Current, Left Clutch Current (either with the actual equipment clutches or by means of test-set-contained dummy loads; the voltage across each clutch, or dummy load ; aircraft battery voltage as it appears at the ARCON Amplifier Unit; and the voltage of each phase of the 3 phase 400 cps power supply.
Lear Model 2244	ARCON Gyro Substitute Test Set	This set provides a simulated Rate Gyro Signal, provides a dummy motor load, and provides indicator lights to check the power used to operate the gyro.
Simpson Model or equivalent	20,000 ohm/volt meter	
Lear P.N.'s 9262262-01 95628 703361	 Torque Wrench Capstan Jig Clutch Adapter	Provide a means for adjusting the mechanical slip clutch output torque.
Lear P.N. 705136	Gear Puller	Provides a means of pulling the output pinion for the disassembly of the Model 3000 C2 and D2 Servos.

2. Customer Failure Reports

Reports of failure from a customer may be due to trouble in the ARCON or a misunderstanding, on the part of the customer, as to exactly what the capabilities and limitations of the equipment are.

Before resorting to lengthy trouble shooting procedures, always check the customer's airplane to insure that the ARCON has actually failed.

a. "The ARCON Will Not Hold a Heading"

The Model 1-A ARCON is not intended to hold a heading. It has no compass directional reference.

b. "The ARCON Seems 'Sloppy' in Smooth Air"

The ARCON is operated by rate of turn. In smooth air, natural turning movements of a well trimmed aircraft take place slowly, at a rate below the threshold level of the ARCON. Once more: The ARCON Model 1-A is not a heading holding device.

c. "The Rate of Turn, Using the Turn Control, Varies"

This is natural. The rate of turn using the ARCON Turn Control will vary with aircraft loading, and speed, as well as with air condition. The variation is due to the fact that the ARCON controls the rudder only. See paragraph IV(1) of the ARCON Operation Manual.

d. "After Executing An ARCON Turn, a Wing Stays Down"

This, too, is natural, particularly in smooth air. See paragraph V of the ARCON Operation Manual.

e. "The Plane Drifts Constantly in One Direction with the ARCON Engaged"

Poor manual trimming is the cause of most customer trouble of this kind. The airplane must be as nearly perfectly trimmed manually as possible before the ARCON is engaged (see paragraph III(2) of the ARCON Operation Manual). Constant drift, requiring the TRIM Control to be advanced to one stop or the other, may also be due to a failure in the rate gyro (see below).

f. "The Rate Gyro Makes Noise When Executing Turns During Taxiing"

This effect is harmless. It is caused by the rate gyro coming up against its safety stops.

3. Test Set Connection

Figure 3-3 shows the method by which the ARCON test sets are connected into the system.

4. Trouble Shooting Procedures

a. Flight Trouble Chart

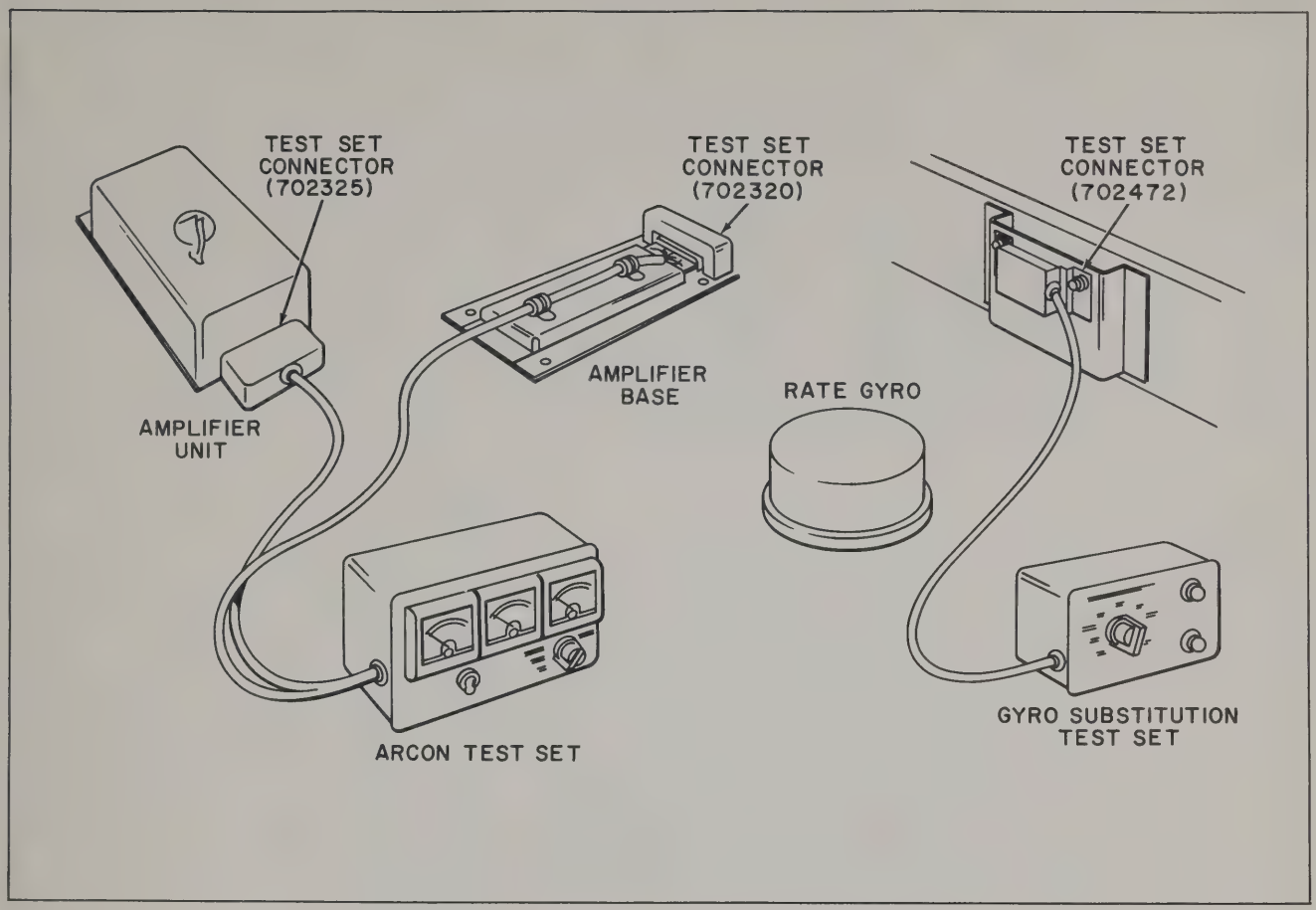


Figure 3-3. ARCON Test Set and Gyro Substitution Test Set Connections

Table 3-2 is a Flight Trouble Localization Chart which will assist in evaluating customer failure reports as well as in analyzing trouble encountered during flight tests. The chart is arranged in an order of checks to be performed. Each conclusion as to trouble cause is valid only if the checks preceding the check involved have been performed. Read paragraph 2 of this section before using the Flight Trouble Chart.

b. Trouble Localization Chart

Table 3-3, the ARCON Trouble Localization Chart, is intended to be used in conjunction with the ARCON Test Set, and the Gyro Substitution Test Set. To be valid, the items must be checked in the order listed.

5. Voltage and Resistance Data

a. Test Conditions:

The following are the test conditions under which the voltage and resistance measurements in Figure 3-4 were obtained.

Instrument: 20,000 ohm/volt meter

Primary Power: 13.75 ± .1 volt, or 27.5 ± .2 volts

Quiescent: Adjusted for equalized 15 ma clutch currents

Gain Control: Maximum gain (full clockwise)

TABLE 3-2. FLIGHT TROUBLE LOCALIZATION CHART

ITEM	ACTION OR CONDITION	EVIDENCE OF CORRECT OPERATION	FAILURE SYMPTOM	PROBABLE TROUBLE IF FAILURE IS EVIDENT	CORRECTIVE MEASURE
1. System Operation	PWR switch to PWR, engage switch pulled out.	ARCON takes control of the aircraft rudder.	ARCON has no effect of any kind.	Power failure, or ARCON system failure.	Proceed with trouble localization procedure, Table 3-3.
				Slip clutch torque set too low.	Reset slip-clutch torque to recommended setting.
2. Control in straight flight	Trim aircraft out and engage ARCON, following instructions in paragraph III-2 of ARCON Operating Instructions.	Aircraft holds straight flight, making no turns in excess of 15° per minute.	Constant hard-over signal.	Clutch connections reversed from amplifier to servo.	Exchange connections between pins H and C of P1 or B and C of P4.
				Rate gyro failure. Magnetic clutch failure. Amplifier output circuit failure. Controller failure.	Proceed with trouble localization procedure, Table 3-3.
			"Jitter" is encountered.	Poor quiescent adjustment (quiescence set too high).	Readjust quiescent current (see paragraph 8c(3), below).
				Bad rate gyro installation.	Check that rate gyro is not installed at point of high vibration.
				Bad rate gyro.	Make checks indicated in Table 3-3. If system checks out OK replace the rate gyro.
			ARCON control is sloppy - allows turn of over 15° per minute to be executed before corrective force is applied.	Trouble may be caused by poor manual trimming.	Retrim aircraft with ARCON disengaged.
				Rate gyro gain set too low. Quiescent adjustment improperly made (quiescence set too low).	Remake quiescent and RG gain adjustments as instructed in paragraph 8c(3).
				Slip clutch torque set too low.	Reset slip-clutch torque to recommended setting.
				High control friction in aircraft.	Check rudder cable friction.
				ARCON amplifier or motor alternator failure.	Follow Trouble Localization Procedure in Table 3-3.
			ARCON causes continuous drift in one direction.	Aircraft poorly trimmed manually. ARCON poorly trimmed.	Retrim plane. Retrim TRIM Control.

				ARCON system failure.	Follow Trouble Localization Procedure, Table 3-3.
3. Control in Turns	Execute 180° turn to the left, 180° turn to the right using ARCON TURN control. Return TURN control to straight up position.	Aircraft executes turns at rate consistent with plane loading, speed, etc., then returns to straight flight (sometimes with one wing low) within 16 seconds after TURN control is pointed straight up.	Aircraft does not return to straight flight.	TURN control not properly pointed for straight flight. ARCON system failure.	Recheck TRIM and TURN control settings. Follow Trouble Localization Procedure, Table 3-3.

TABLE 3-3. TROUBLE LOCALIZATION CHART

ITEM	ACTION OR CONDITION	EVIDENCE OF CORRECT OPERATION	PROBABLE TROUBLE IF EVIDENCE OF CORRECT OPERATION IS NOT OBTAINED	CORRECTIVE MEASURE
1. Primary Power	ARCON Test Set Hook-up as shown in Fig. 3-3. PWR switch to PWR. Circuit Test switch to battery. Do not connect gyro substitution Test Set.	Circuit test meter reads 14 or 28 volts, depending upon primary source.	Discharged battery. High resistance in battery line. Short circuit in ARCON motor alternator.	Charge battery. Measure resistance in battery line. Check motor alternator for short circuit. Replace unit if necessary.
2. A-C Power	Engage-Disengage Switch engaged. Circuit test switch as follows:	Circuit test meter reads as follows:	If no readings obtained cable wires leading from terminals C, D, and E at P3 are either open or shorted, or alternator has failed completely.	Check cable and alternator. Replace alternator if necessary.
	Phase A	100 ± 15%		
	Phase B	95 ± 15%	If no reading obtained in one phase, high reading on other two phases, cable connection or winding for affected phase is open.	Check affected cable lead and alternator winding. Replace alternator if necessary.
	Phase C	115 ± 15%		
			If no reading obtained on one phase, low reading on other two phases, cable connection or winding for affected phase is shorted.	Check affected cable lead and alternator winding. Replace alternator if necessary.
3. Clutch Quiescent (centering) and Voltage	LOAD switch to dummy Center TURN control. Adjust TRIM control to balance clutch current equally to right and left clutches.	Clutch Current meters both read 15 ma.	If current is low or high in both meters, QUIESCENT adjustment is improperly made.	Adjust QUIESCENT potentiometer. See paragraph 8c(3).
			If improper current in one meter, normal current in other meter, and balance cannot be restored with	Check (Right Clutch current low) BR1, T3, D1, D2, (Left Clutch current low) BR2, T4, D3, D4.

TABLE 3-3. TROUBLE LOCALIZATION CHART (Cont)

ITEM	ACTION OR CONDITION	EVIDENCE OF CORRECT OPERATION	PROBABLE TROUBLE IF EVIDENCE OF CORRECT OPERATION IS NOT OBTAINED	CORRECTIVE MEASURE
3. (Cont)			TRIM control, failure is in Amplifier channels or Controller (Hard-over signal).	Check TURN and TRIM controls (see Item 5, below).
4. Magnetic Clutch	LOAD switch to CLUTCH. Circuit Test switch to L. Clutch and R. Clutch.	Clutch current meters both read 15 ma. Circuit test meter reads 1.75 - 3.0 on both clutches.	If readings incorrect for both clutches, cable is shorted or open. If current is high, voltage low in one clutch, short circuit exists in clutch or applicable cable lead. If current is low, voltage high, in one clutch, open exists in clutch or applicable cable lead.	Check between pins B-A, C-A of P4 for short or open. Check appropriate clutch and cable for short circuit. Replace clutch if necessary. Check appropriate clutch and cable for short circuit. Replace clutch if necessary.
5. Turn and Trim Controls	Set TURN Control and TRIM controls as follows: Trim: Center Turn: Full Right Full Left Center Trim: Full Right (CW) Full Left (CCW)	Clutch current meters, read as follows: Right / Left - - - - - - - - - (Quiescent) 35-60 ma / 0-5 ma 0-5 ma / 35-60 ma - - - - - - - - - (Quiescent) 35-60 ma / 0-5 ma 0-5 ma / 35-60 ma	If incorrect readings obtained, Controller unit, interconnecting cabling, bridge rectifiers are faulty, or Rate Gyro has failed.	Check TURN and TRIM controls. Check BR1, BR2 as applicable. Check Rate Gyro.
6. Rate Gyro	Set TURN control to center. Set TRIM control for balanced clutch current. Connect Gyro substitution test set as shown in Figure 3-3. Set rate of TURN/MIN as follows: Right 180° Left 180° (Center) 0°	A-B, A-C Lamps Light. CLUTCH current meters read as follows: Right / Left 35-60 ma / 0-5 ma 0-5 ma / 35-60 ma 15 ma / 15 ma	If one or both lamps fail to light, failure is in alternator or interconnecting cabling. If proper readings are obtained with Gyro test set, but gyro exercises poor airborne rudder control RG gain is set too low, or rate gyro has failed. If incorrect readings are obtained with gyro test set, Amplifier channels have failed.	Recheck items 1 and 2 of this table. Set RG Gain Control fully clockwise. Replace Rate Gyro if necessary. Check BR1, BR2, T3, T4.

Tolerance of Measurements: ± 20%

Unless otherwise noted, all measurements are to ground (terminal A or N of P1).

b. Voltage and Resistance Measurements:

Typical voltage and resistance measurements are shown in Figure 3-4.

6. Etched Circuit Servicing Techniques

Exercise care in soldering etched circuit parts. To avoid subjecting the board to excessive heat do not use a soldering iron larger than 35 watts.

If too much heat is used, a circuit bond to the base cord may be loosened. When this occurs, recement the loose line to the cord. If for any reason a line becomes broken, repair it by soldering a bare copper wire across the break. Lap the wire 1/4" either side of the break and paint the affected area with clean lacquer after soldering.

The leads of resistors and capacitors have been crimped on the soldered side of the cord. To remove one of these components, it is necessary to cut the component lead on the solder side of the cord as close to the cord as possible, then carefully withdraw the component and the remainder of its lead as the solder is melted.

Use extreme care when soldering or unsoldering diode rectifiers. A small amount of heat will make a diode inoperative. Always use a heat sink (pliers, etc) when working the leads of a rectifier. Never employ a soldering iron larger than 35 watts.

In the removal of magnetic amplifiers and transformers, it is necessary to heat each of the leads in rotation, withdrawing them a little at a time. Be extremely careful not to apply excessive heat or pressure.

Figure 3-5 illustrates a special soldering iron tip that may be fabricated to facilitate the removal of the amplifiers and transformers from the ARCON etched circuit board or any other board mounting similar components.

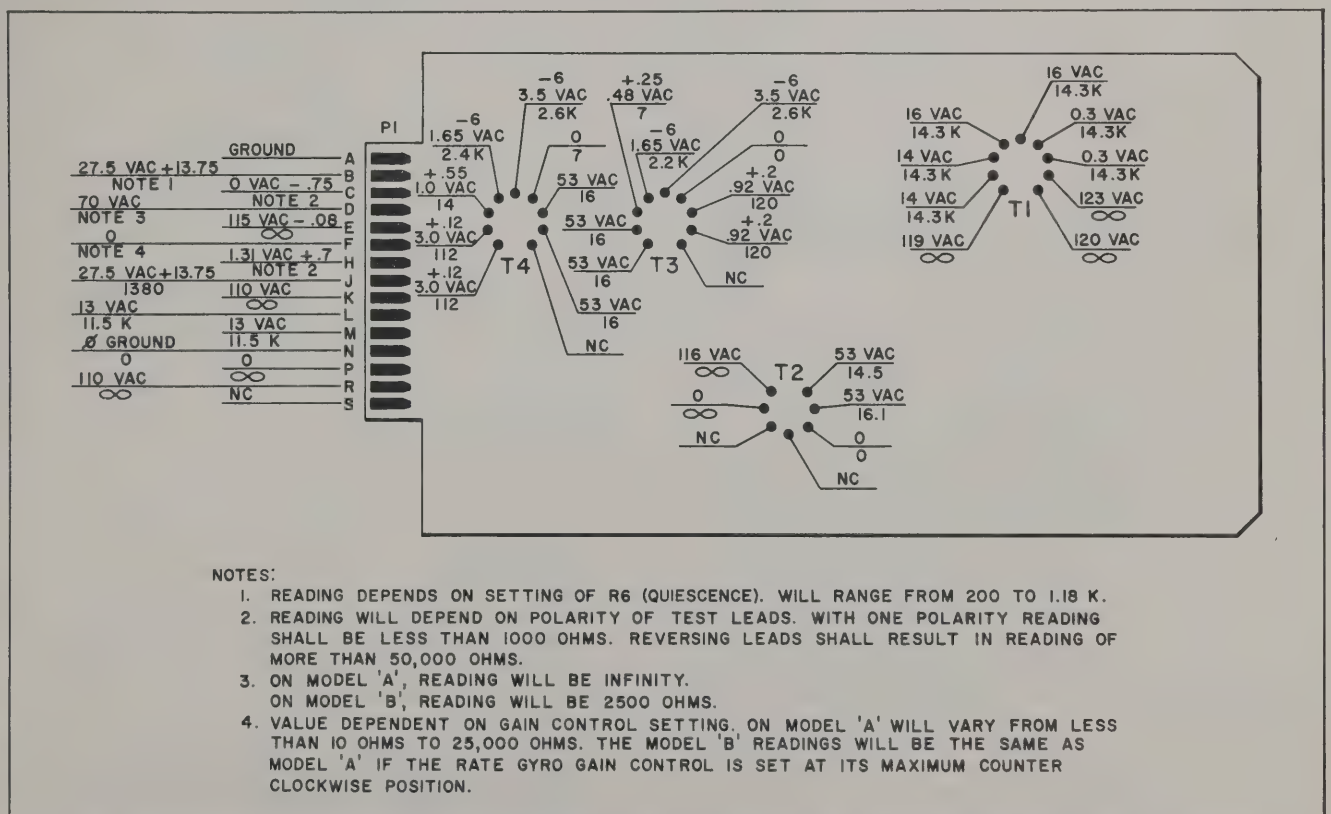
7. Disassembly of the Alternator-Servo Assembly

a. General

It is necessary to inspect the brushes in the Servo Assembly after every 500 hours of operation. This inspection cannot be performed without disassembly of the servo assembly.

The Motor Alternator assembly may be separated from the servo assembly by removing the six safety-wound screws connecting the two assemblies together.

There are two distinct types of servo assemblies in field ARCON installations, each of which have different and critical disassembly procedures. Follow these instructions carefully before attempting to disassemble a servo assembly. To identify the different models, examine the reach gear. The model 3000 A and B, C1 and D1 servos have a pin



NOTES:
1. READING DEPENDS ON SETTING OF R6 (QUIESCENCE). WILL RANGE FROM 200 TO 1.18 K.
2. READING WILL DEPEND ON POLARITY OF TEST LEADS. WITH ONE POLARITY READING SHALL BE LESS THAN 1000 OHMS. REVERSING LEADS SHALL RESULT IN READING OF MORE THAN 50,000 OHMS.
3. ON MODEL 'A', READING WILL BE INFINITY.
   ON MODEL 'B', READING WILL BE 2500 OHMS.
4. VALUE DEPENDENT ON GAIN CONTROL SETTING. ON MODEL 'A' WILL VARY FROM LESS THAN 10 OHMS TO 25,000 OHMS. THE MODEL 'B' READINGS WILL BE THE SAME AS MODEL 'A' IF THE RATE GYRO GAIN CONTROL IS SET AT ITS MAXIMUM COUNTER CLOCKWISE POSITION.

Figure 3-4. Typical Voltages and Resistances in the ARCON Amplifier

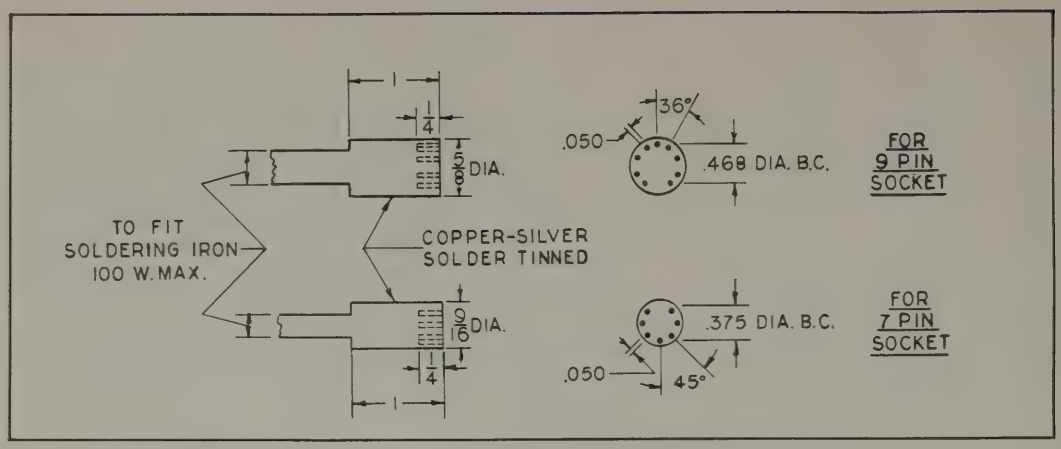


Figure 3-5. Etched Circuit Component Solder Iron Tip

retaining the reach gear to the output shaft. The reach gear in the model C2 and D2 servo is welded to the shaft. Refer to Figure 3-6.

b. Disassembly of the Model 3000 A, B, C1 and D1 Servos

1. Carefully remove the pin holding the reach gear in place. DO NOT BEND or otherwise distort the pin, since it must be re-used when the unit is re-assembled.

2. Remove the reach gear.

3. Remove the screws holding the back plate in place.

4. Remove the snap ring holding the output drive shaft bushing in place.

5. Remove the back plate.

6. To remove the clutches in the model 3000 A and B, remove the three screws holding each clutch in place and withdraw the clutch. For other models, see below.

c. Disassembly of the Model 3000 C2, D2, Servos

1. Remove the four screws holding the slip clutch assembly in place.

2. Remove the six safety-wired screws joining the clutch assembly and the motor-alternator itself.

3. Remove the snap ring holding the output gear bushing.

4. Remove the eight flat-head (Phillips head) recessed screws mounting the front plate on the clutch housing.

5. Remove the front plate.

6. Push the Reach gear forward until it "bottoms" against the housing.

7. Place the gear puller (Lear Part No. 705136) on the seat of the output shaft retaining bushing, in the position normally occupied by the front plate.

8. Replace the snap ring to hold the puller in place.

9. Insert the gear puller in a vise so that the feet of the puller are firmly clamped in place to prevent their spreading. Do not clamp the puller so tightly as to distort the bushing.

10. Pull the output pinion.

11. The remainder of the assembly may be easily disassembled from this point.

To reassemble the servo assembly, proceed as follows:

NOTE

Always install a new output shaft thrust bearing after disassembling the Model C2 and D2 Servos.

12. Replace the clutches and the output shaft.

13. Lubricate the drive pinion end of the output shaft with an air dry brush-on moly-disulfite lubricant such as LUBRIBOND type "B".

14. Place the reach gear end of the output shaft against a firm base.

CAUTION

Make certain the shaft, not the reach gear is supported.

15. Place the assembly in a suitable arbor and press the output pinion gear carefully into place. If no arbor is available, use a drill press.

CAUTION

The output pinion must be pressed straight into place. Any cocking will result in unsatisfactory operation or outright failure of the servo unit.

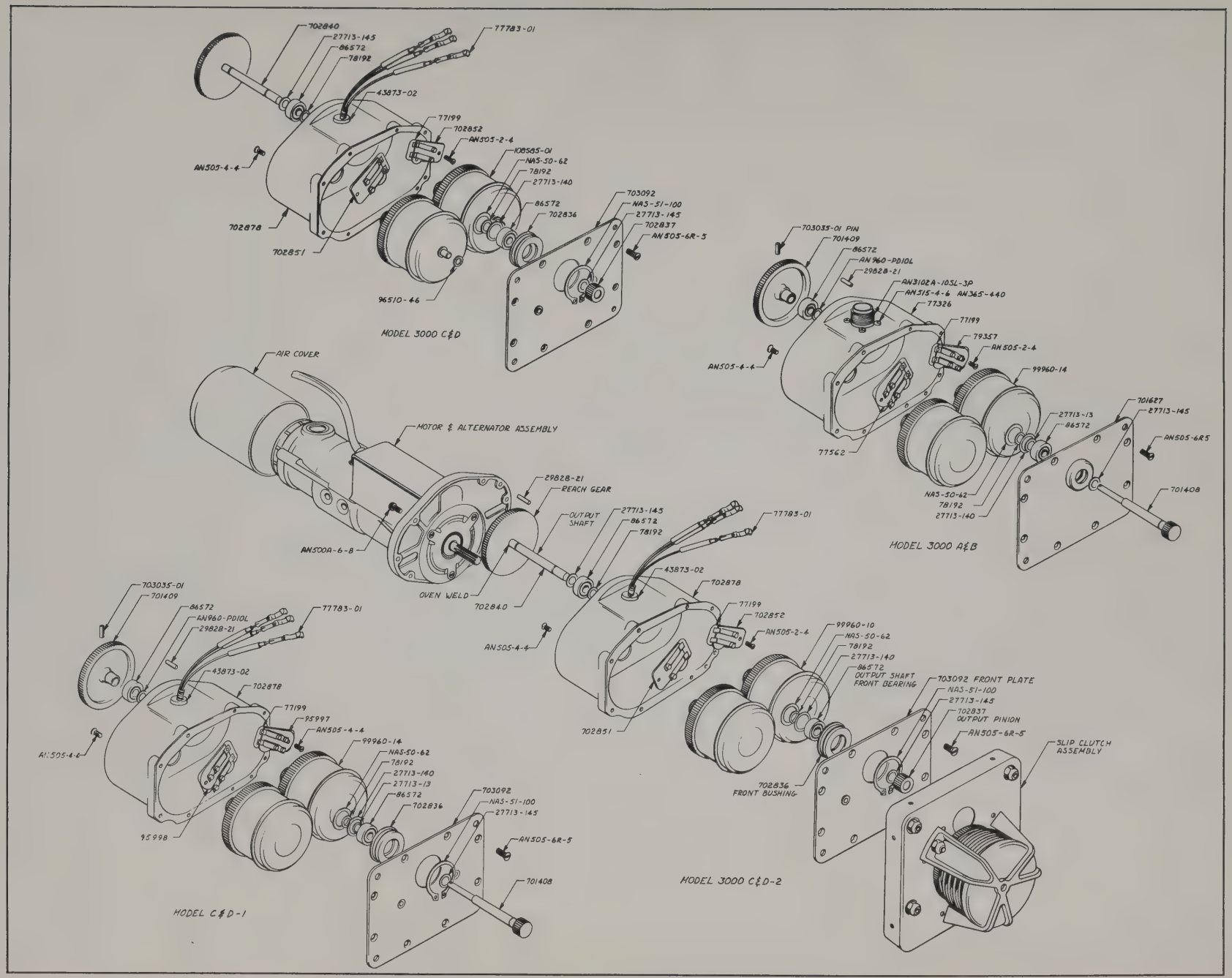


Figure 3-6. Disassembly of Motor-Alternator and Servo Assembly

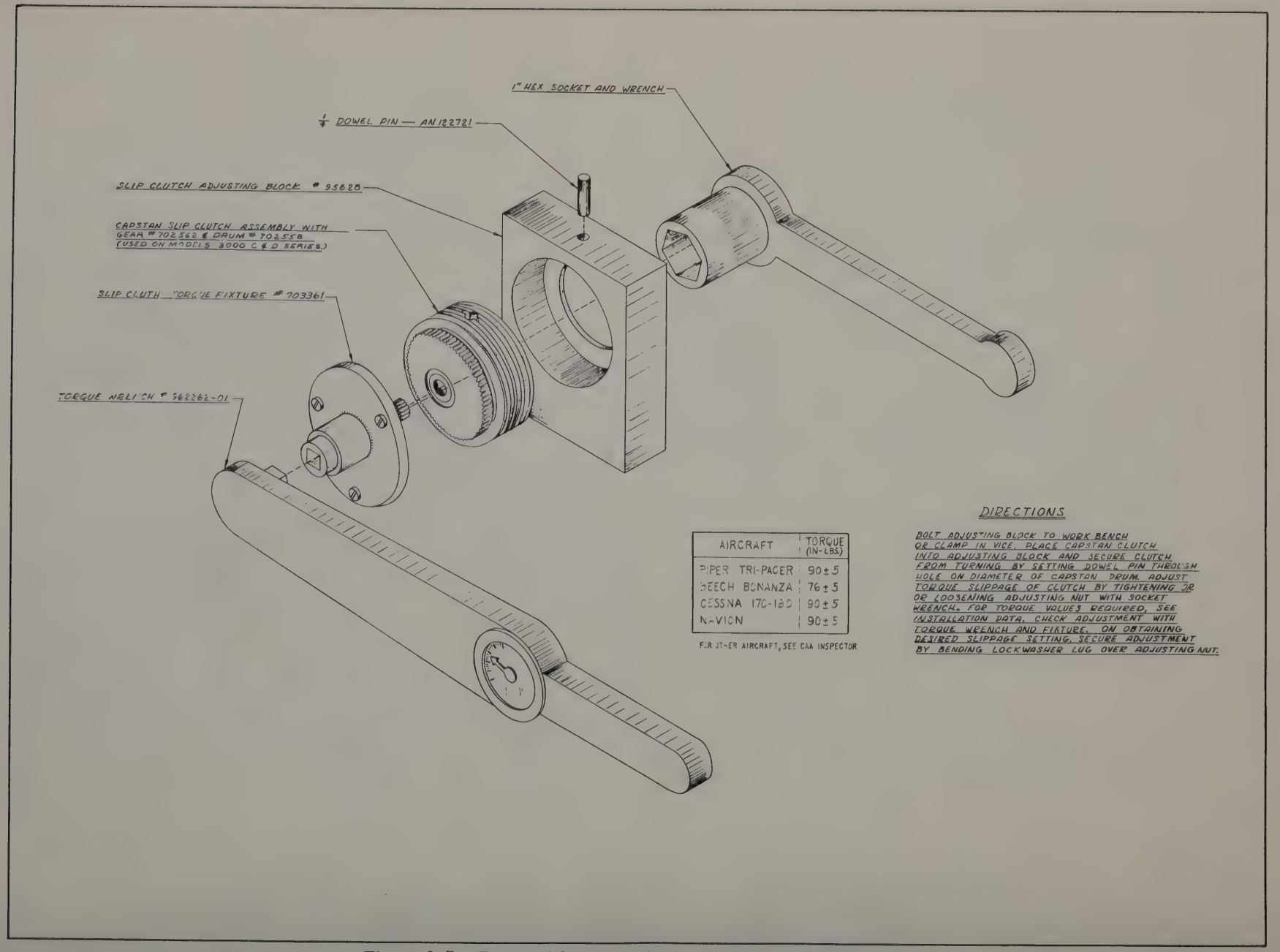

1" HEX SOCKET AND WRENCH
¼ DOWEL PIN — AN122721
SLIP CLUTCH ADJUSTING BLOCK # 95628
CAPSTAN SLIP CLUTCH ASSEMBLY WITH GEAR # 702562 & DRUM # 702558 (USED ON MODELS 3000 C & D SERIES.)
SLIP CLUTH TORQUE FIXTURE # 703361
TORQUE WRENCH # 562282-01
AIRCRAFT | TORQUE (IN-LBS.)
PIPER TRI-PACER | 90±5
BEECH BONANZA | 76±5
CESSNA 170-180 | 90±5
NAVION | 90±5
FOR OTHER AIRCRAFT, SEE CAA INSPECTOR
DIRECTIONS
BOLT ADJUSTING BLOCK TO WORK BENCH OR CLAMP IN VICE. PLACE CAPSTAN CLUTCH INTO ADJUSTING BLOCK AND SECURE CLUTCH FROM TURNING BY SETTING DOWEL PIN THROUGH HOLE ON DIAMETER OF CAPSTAN DRUM. ADJUST TORQUE SLIPPAGE OF CLUTCH BY TIGHTENING OR OR LOOSENING ADJUSTING NUT WITH SOCKET WRENCH. FOR TORQUE VALUES REQUIRED, SEE INSTALLATION DATA. CHECK ADJUSTMENT WITH TORQUE WRENCH AND FIXTURE. ON OBTAINING DESIRED SLIPPAGE SETTING, SECURE ADJUSTMENT BY BENDING LOCKWASHER LUG OVER ADJUSTING NUT.

Figure 3-7. Torque Adjustment for the Mechanical Slip Clutch

16. Replace the front cover, the bearing and the snap ring.

8. ARCON System Adjustments

Following any repair or overhaul procedures, and in new installations, it is necessary to make the adjustments required for the equipment to perform properly in the air. To make these adjustments, proceed as follows:

a. Mechanical Clutch Torque Adjustment

1. The mechanical slip clutch in the servo unit must be adjusted on a bench using the procedure described in Figure 3-7.

WARNING

NEVER adjust the slip clutch beyond the CAA recommended limits shown in Figure 3-7 of this manual. Increasing the slip clutch torque setting does not improve ARCON sensitivity, but merely makes the system more difficult to over-ride in the event of a hard-over signal condition.

2. After adjusting the slip clutch torque, reassemble the servo and install it in the aircraft.

b. Ground Adjustments

Perform the checks listed in the trouble localization chart (Table 3-3) adjusting the quiescent current if necessary, and correcting any failures indicated by the chart.

NOTE

The RG Gain is normally kept in the maximum clockwise position (see 3, below).

c. In Flight Adjustments

1. Equipment Hook-up

Connect the ARCON Test Set before take-off as shown in Figure 3-3. DO NOT connect the gyro substitution Test Set.

2. Flight Test

After fifteen minutes of flight with the PWR switch in the PWR position, perform the checks listed in Table 3-3 with the ARCON Test Set LOAD switch in the CLUTCH position. If any trouble is encountered, it is probable that the ground checks were not properly performed or that the quiescent current has changed to an incorrect value due to the higher in-flight primary power caused by generator operation.

3. Quiescent Current and RG Gain Adjustment

NOTE

This in-flight adjustment must be performed in still air.

The ideal quiescent current will vary in different aircraft between 14 and 18 ma. Too low a quiescent current will cause sloppy operation. Too high a quiescent current will cause overloading of the motor-alternator, and can cause "jitter" and overshoot in the system. To adjust the quiescent current, proceed as follows:

1) Set the ARCON for straight flight and observe the CLUTCH CURRENT meters. They should both read 15-18 ma (when the system is at rest) if ground adjustment has been properly made.

2) Kick in a small amount of right rudder by overriding the ARCON with manual control. Use enough rudder to produce a turn of about 15 degrees per minute.

3) Release the right rudder and observe the corrective action of the ARCON.

4) If the ARCON arrests the yaw, without objectionable overshoot, do not readjust the quiescent current.

NOTE

The ARCON will not return the aircraft to its original heading. It will arrest the yaw.

5) If the ARCON reaction seems slow, increase the quiescent current to 18 ma. Do not exceed 18 ma.

6) Make a fast turn and allow the ARCON to arrest the yaw motion.

7) If the ARCON overshoots in still air, reduce the quiescent current. Do not reduce the current below 14 ma.

8) If the ARCON continues to cause overshoot, or if jitter continues after the quiescent current has been reduced to its minimum value, reduce the setting of the RG Gain control just enough to prevent overshoot.

NOTE

Overshoot and jitter can also be caused by Gyro mounting at a point of too-high vibration.

9. 500 Hour Check

The following preventive maintenance procedures must be performed every 500 hours to insure continued customer satisfaction with the equipment.

a. Maintenance Procedures

1. Remove the ARCON from the aircraft.

2. Open the Amplifier and Controller Units. Clean the etched circuit in the Amplifier. Clean the potentiometers in the Controller with carbon tet. Remove any rust that may have accumulated on the units and apply paint or other rust preventitive as applicable.

3. Disassemble the Servo (see paragraph 7b of this section). Inspect the clutch brushes and slip rings for wear. Inspect the gears for wear. Replace any parts necessary. Lubricate the wearing points of the servo assembly (with the exception of the clutch brushes and slip rings) with grease per spec MIL-G-3278 before reassembly.

4. Disassemble the Mechanical Clutch. Inspect the ring gear and the friction surfaces of the clutch for wear. Lubricate the friction surfaces with grease per spec MIL-G-7118 before reassembly.

5. Remove the fan cover from the Alternator and remove any accumulated dust with light compressed air.

6. Reassemble the equipment.

7. Adjust the mechanical clutch torque to the CAA recommended value (see Figure 3-7).

b. Test Procedures

Replace the equipment in the aircraft and perform the ground checks and flight checks listed in Tables 3-3 and 3-2 of this manual.

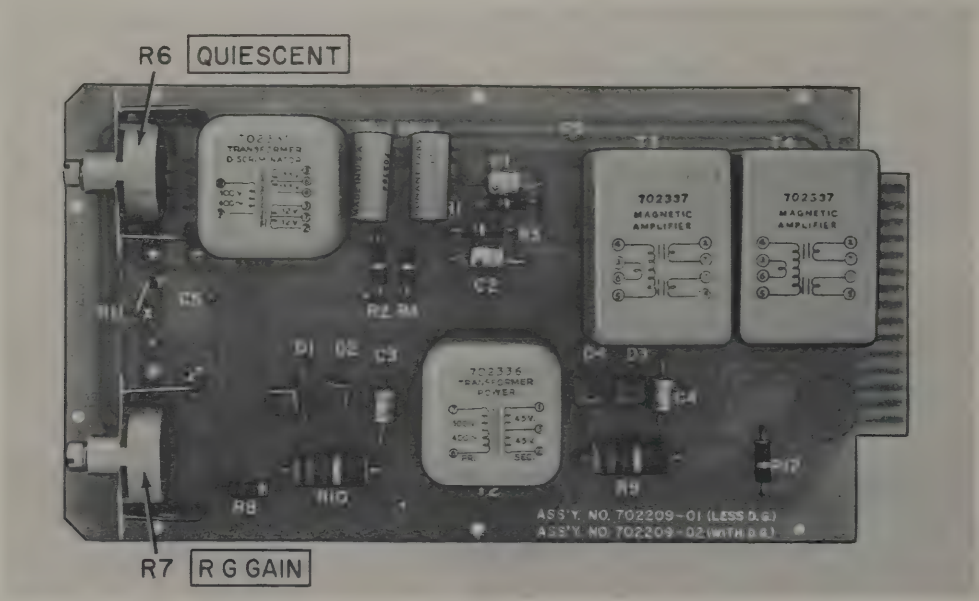
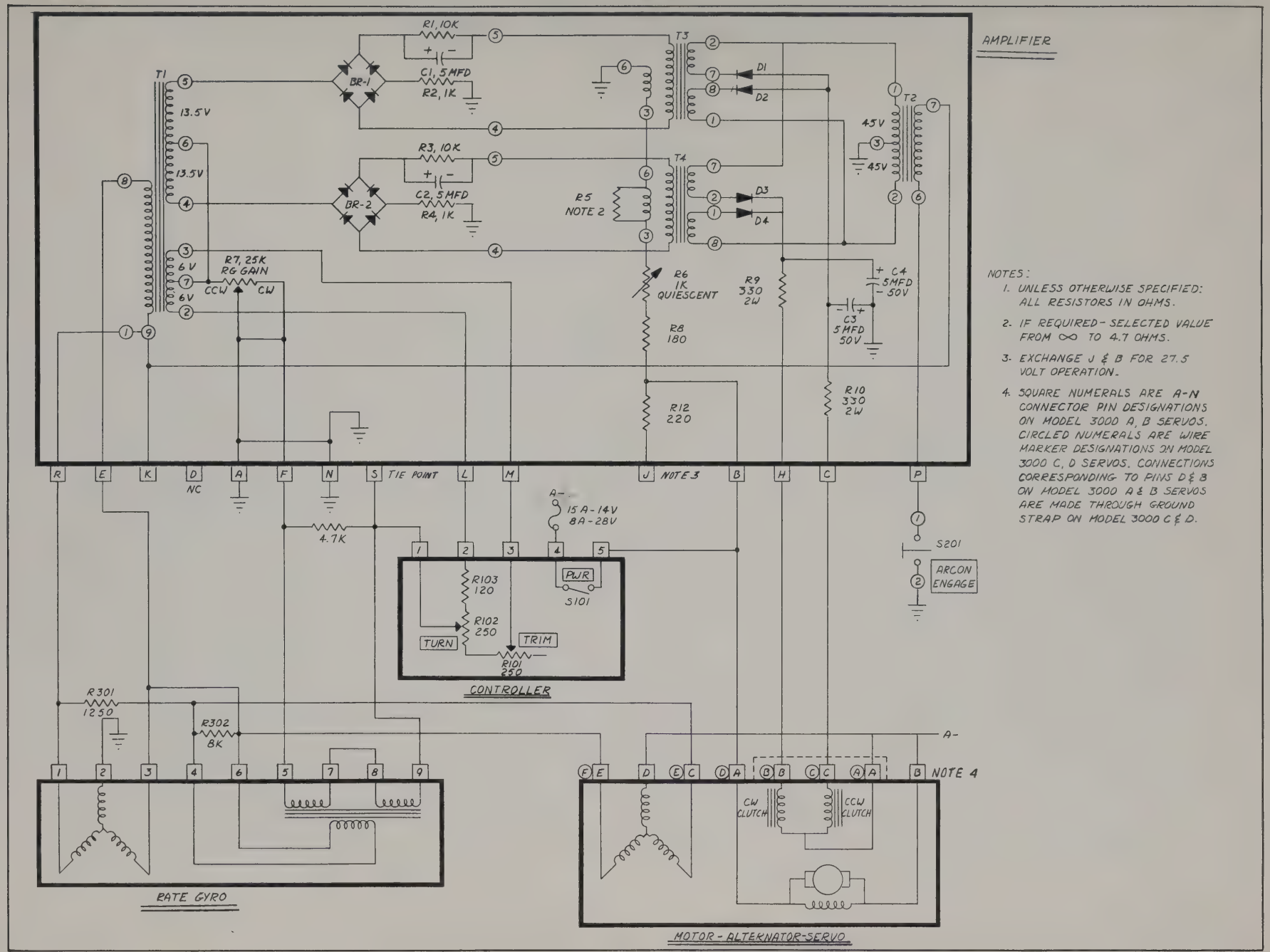


Figure 3-8. ARCON Etched Circuit, Top View



NOTES:

1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS IN OHMS.
2. IF REQUIRED - SELECTED VALUE FROM ∞ TO 4.7 OHMS.
3. EXCHANGE J & B FOR 27.5 VOLT OPERATION.
4. SQUARE NUMERALS ARE A-N CONNECTOR PIN DESIGNATIONS ON MODEL 3000 A, B SERVOS. CIRCLED NUMERALS ARE WIRE MARKER DESIGNATIONS ON MODEL 3000 C, D SERVOS. CONNECTIONS CORRESPONDING TO PINS D & B ON MODEL 3000 A & B SERVOS ARE MADE THROUGH GROUND STRAP ON MODEL 3000 C & D.

Figure 3-9. ARCON System Schematic Diagram

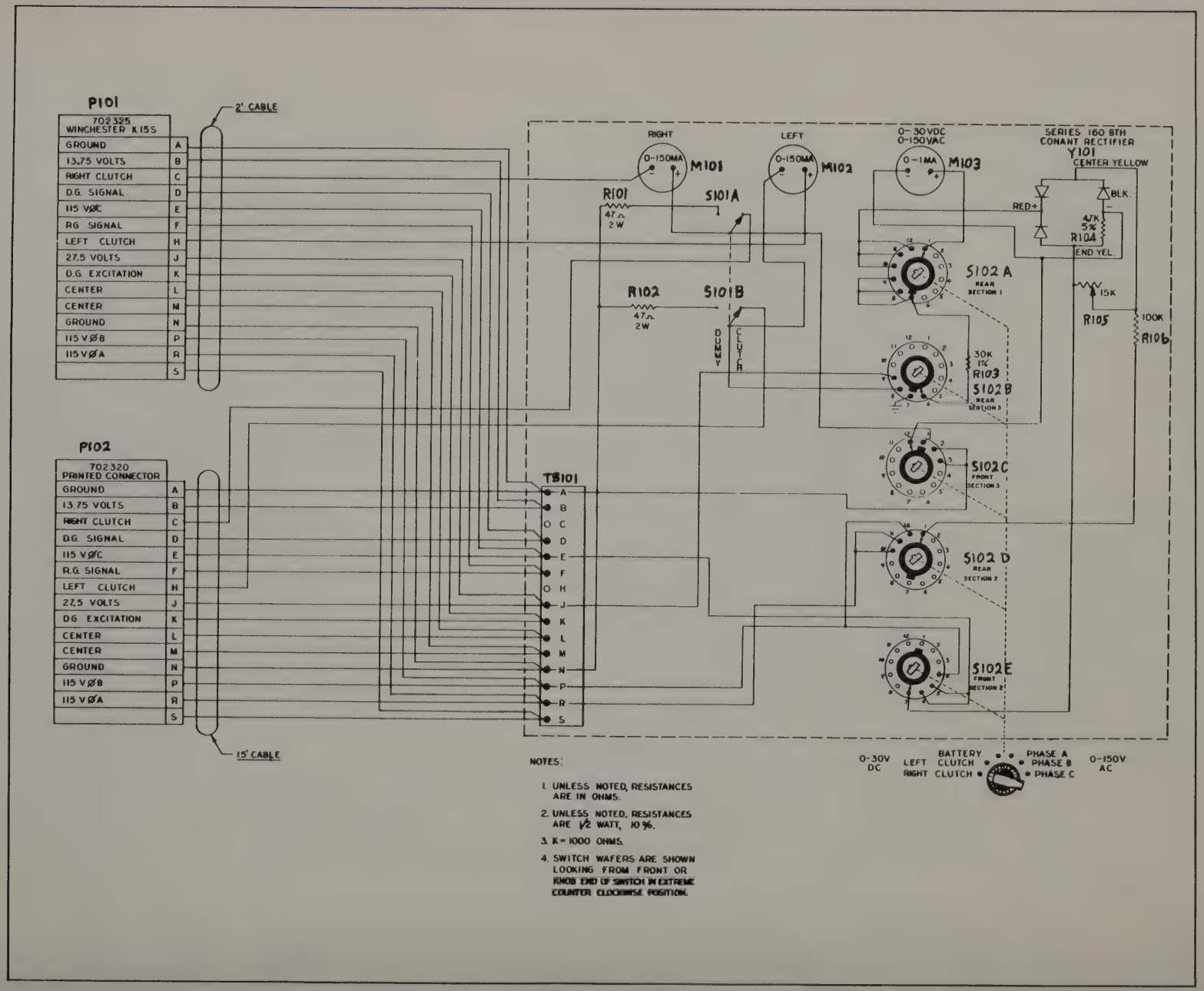


Figure 3-10. ARCON Test Set Schematic Diagram

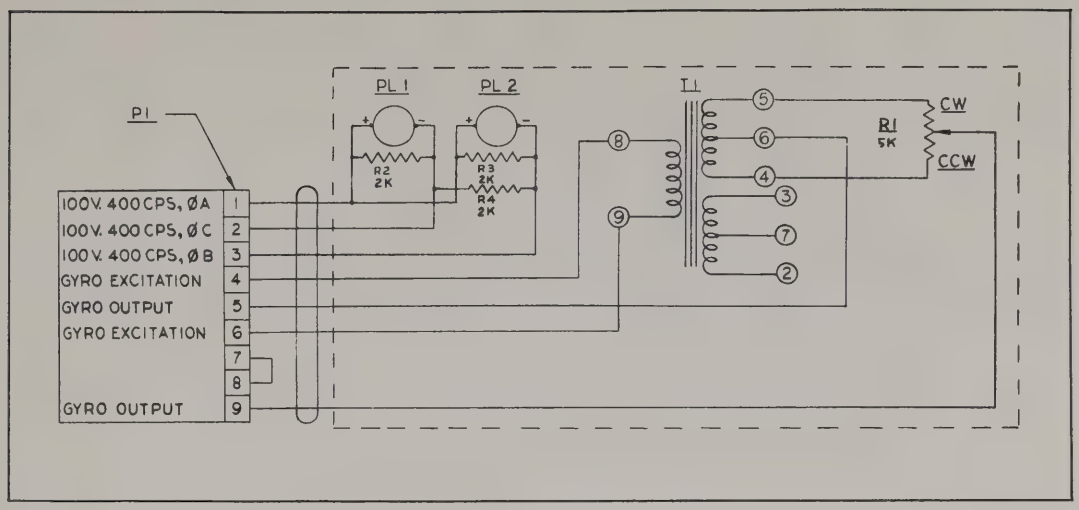
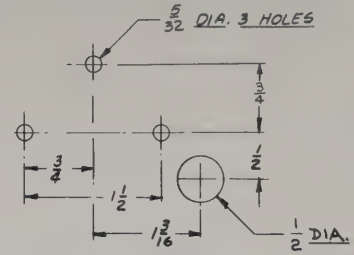


Figure 3-11. ARCON Gyro Substitution Test Set Schematic Diagram

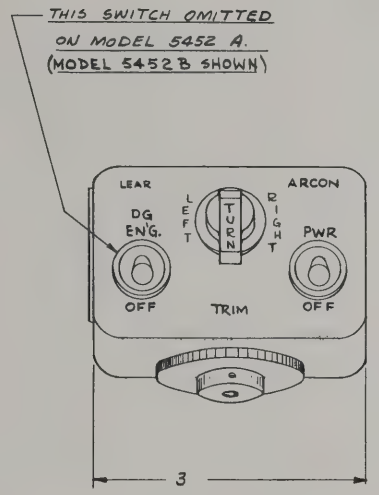
APPENDIX I

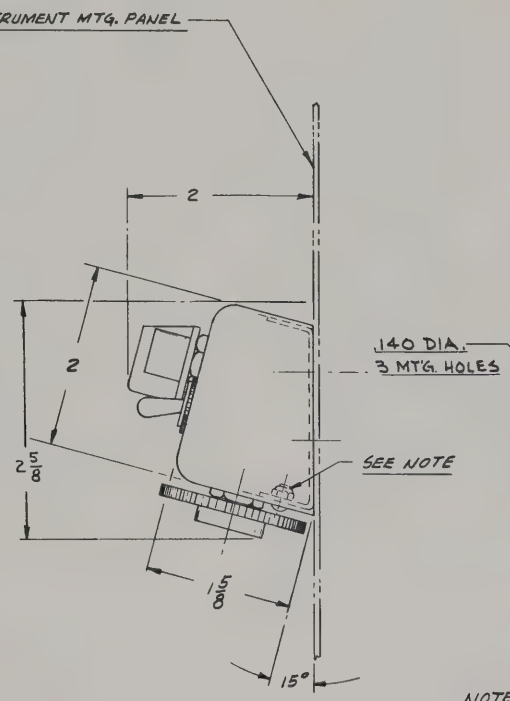
Installation Data. The Installation drawings for the ARCON have been included in this manual for reference only. Fully detailed installation instructions are provided with each ARCON installation kit.

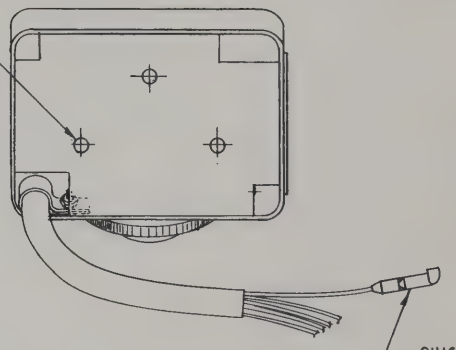
ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.
A	—	RELEASED	10/5/66	J.S.



MTG. HOLE PATTERN







NOTE:
REMOVE SCREW & COVER FOR MTG.
TO INSTRUMENT PANEL

5452-1
DRAWING NO.
A
ISSUE

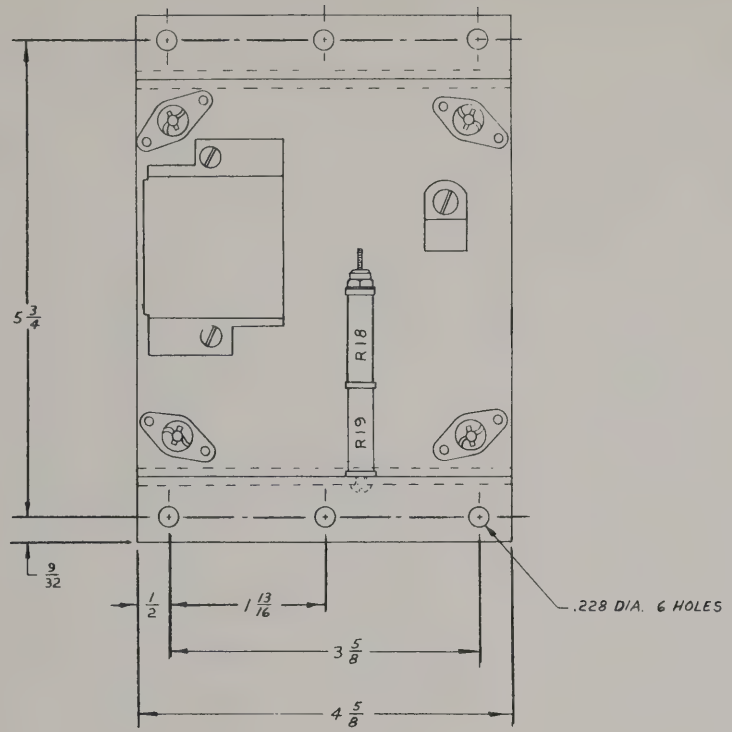
INSTALLATION DRAWING

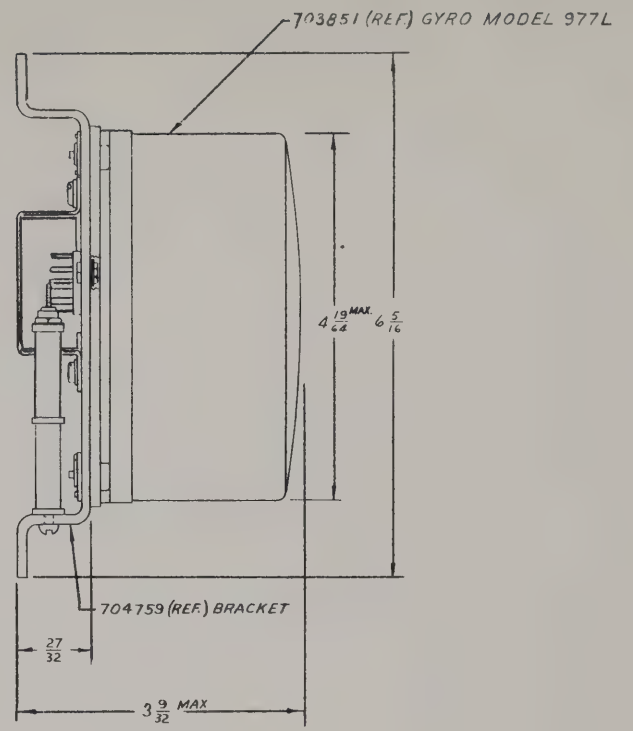
ARCON CONTROLLER MODEL 5452-A&-B

WT: .8 LBS.

EXP. LABS.			⊕-COMMERCIAL PART — SEE DETAIL DRAWING BEFORE ORDERING	WT. LB.	PART REF.	BASIC MODEL 5452
CHECKER			MATERIAL			HEAT TREAT
CHIEF ENGR.			FINISH			
STRESS			THE INFORMATION HEREON IS THE PROPERTY OF LEAR, INCORPORATED, AND IS FURNISHED FOR REFERENCE ONLY. UNAUTHORIZED USE THEREOF IS FORBIDDEN.			LEAR, INC.
MATERIALS			DRAWING TITLE	CATEGORY	DWG.	DRAWING NO.
SALES						
MFG.						
DEVELOPMENT						
PRODUCT	C.L. Brush	10/5/66	INSTALLATION- ARCON CONTROLLER			5452-1
DESIGN	J. Rosch	10/5/66			SIZE	
DRAWN	K Bartin	9/25				

ISSUE	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.
D	9383	SEE ECO	8/11/65	
E	9981	SEE ECO	6/4/68	





702340
E

INSTALLATION DRAWING

RATE GYRO MTG.

WEIGHT: 1.8 LBS

PART No.

The information herein is the property of Lear, Incorporated, and is submitted in confidence for reference only. Unauthorized use by anyone for any other purpose is forbidden.

UNLESS OTHERWISE SPECIFIED
Dimensions apply after Plating and Heat Treating
C' Bors and Spotface Corner Radii .010 Max.
BREAK ALL EDGES
BURR CLASSIFICATION No.
Dimensions are in Inches and Tolerances are:
Decimals ± .005; Fractions ± 1/64, Angles ± ½°
Fractions ± 1/32; Angles ± 1° Between
Sand Cast Surfaces or Sheet Metal Surfaces.
SURFACE ROUGHNESS OF ALL MACHINED SURFACES ✓ RMS

MATERIAL —
FINISH —
HEAT TREAT —

⊙ — COMMERCIAL PART — SEE DETAIL DRAWING BEFORE ORDERING | WT. 1.8 LB. | PART REF. | DASK MODEL ARCON 1A618

SCALE FULL | DO NOT SCALE DRAWING

LEAR, INCORPORATED
GRAND RAPIDS, MICHIGAN, U.S.A.

DRAWN	C. FINK	9-29
DWN.	A. GINDLE	9-29-59
CHKR	W. TOWN	9-29
APP	G.D. DASCHER	9-29-59

DRAWING TITLE: INSTALLATION DATA - RATE GYRO & MOUNTING BKT.

CATEGORY: C | SIZE | DWG DRAWING NO.: 702340

LETTER	CHANGE ORDER NO.	CHANGE	DATE BY	CHK.
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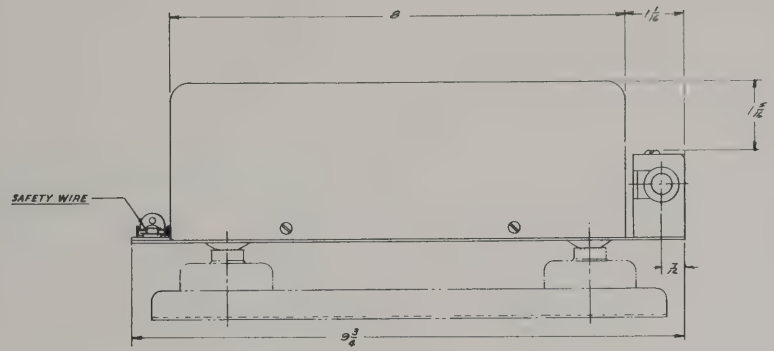
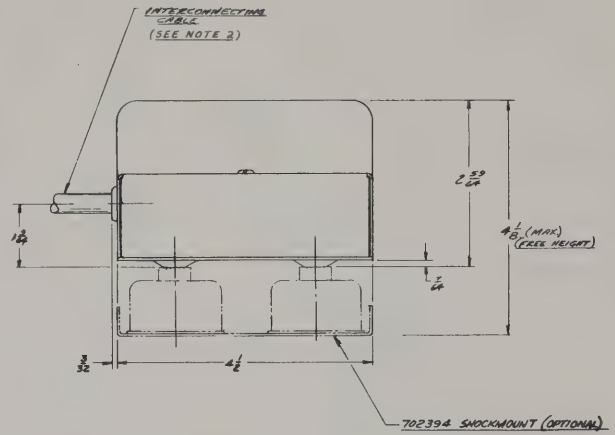
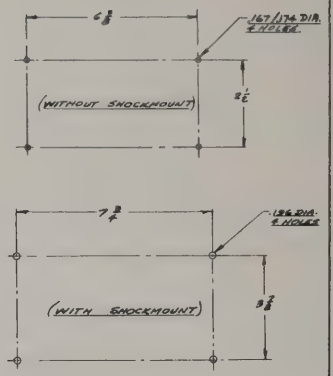
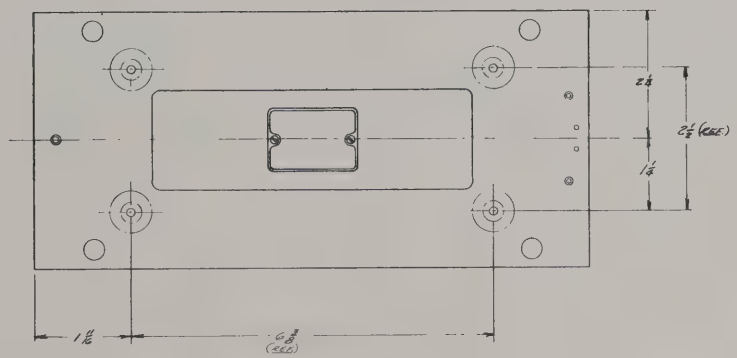
B	7167	SEE ECO		







MOUNTING DIMENSIONS
SCALE - NONE



(BOTTOM VIEW - SHOCKMOUNT OMITTED)

INSTALLATION DRAWING

ARCON AMPLIFIER MODEL 2219-A &B

2219-1

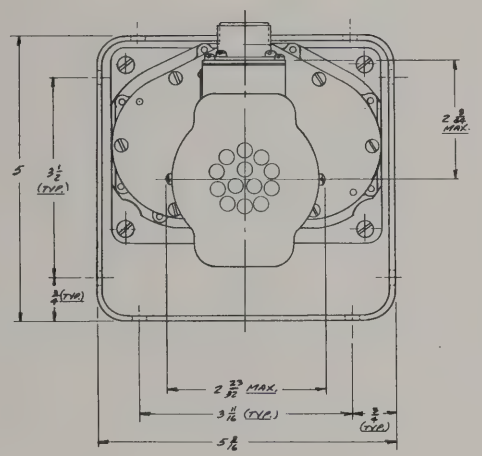
WTS.: AMPLIFIER - 3.0 LBS.
SHOCKMOUNT - 0.75 LBS.

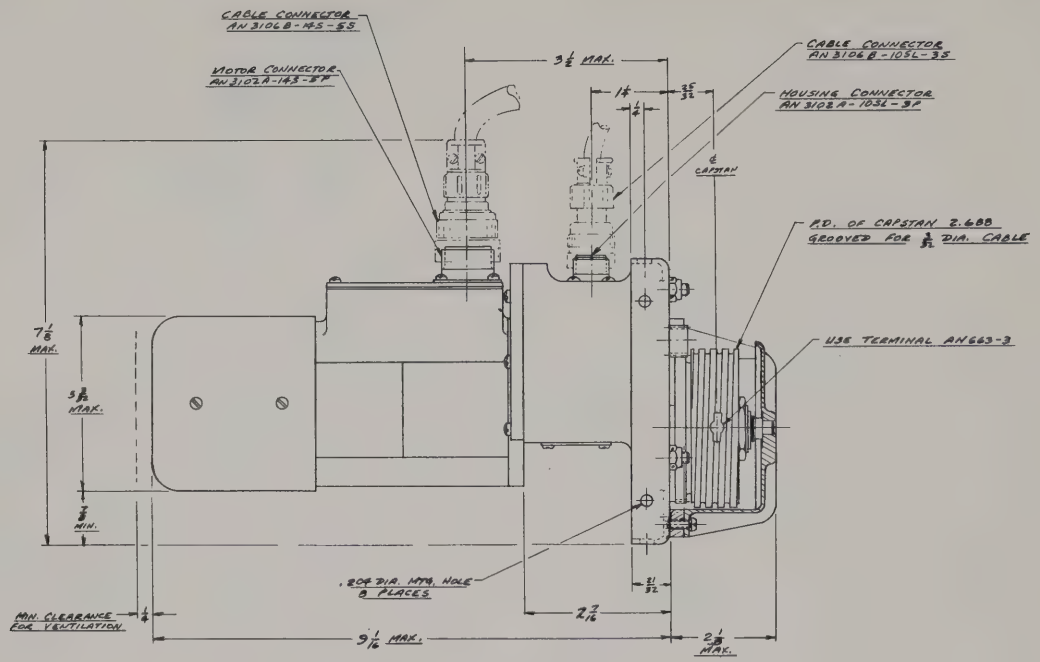
2.- SIX INCH MINIMUM OF FREE CABLE REQ'D. WHEN SHOCKMOUNT IS USED.

1.- FOR WIRING SCHEMATIC SEE DWG. 702322.

NOTES

PART NO.	
MATERIAL	SEE PAGE
FINISH	
LEAR, INC.	
AMPLIFIER - MODEL 2219 INSTALLATION DWG.	D 2219-1



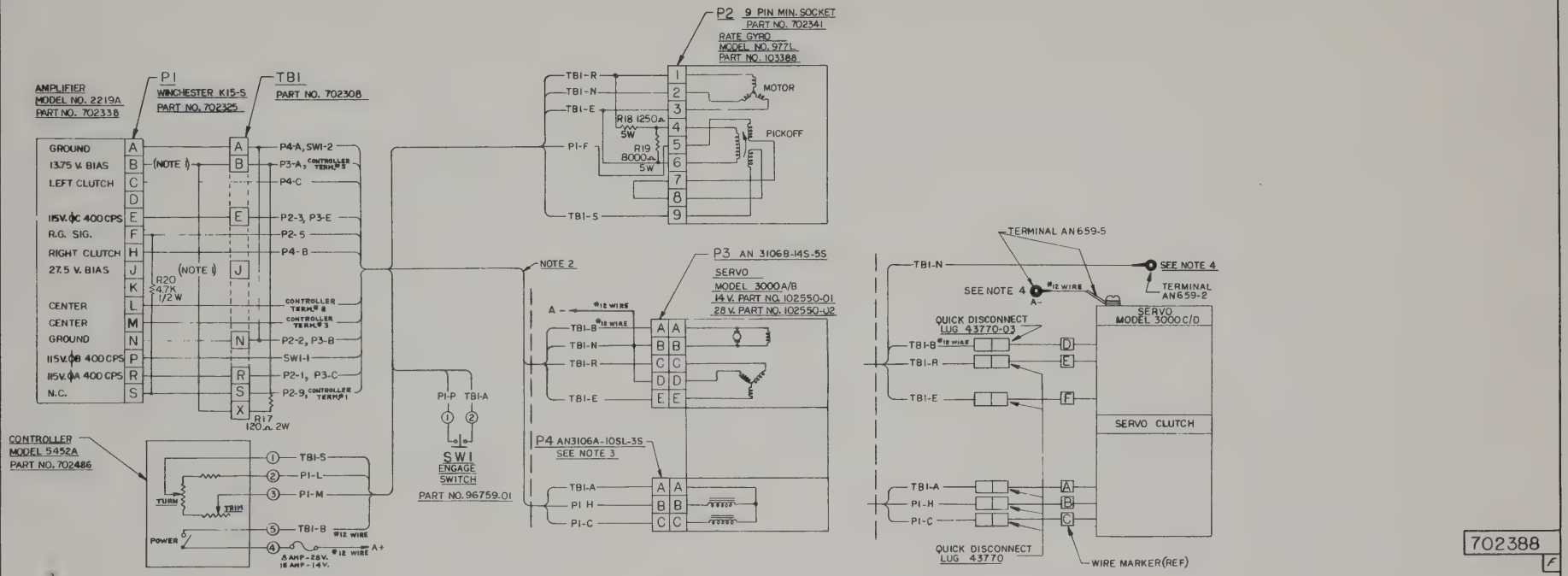


3000-1
A

NOTE:

1. - ASSY. DWG. NO. 701822
2. - SCHEMATIC DIAGRAM NO. 701823
3. - SLIP CLUTCH TORQUE FACTORY SET AT 0 LB-IN. ADEQUATE ADJUSTMENT TO BE MADE AT INSTALLATION IN AIRCRAFT.
4. - CABLE GUARD SCREWS TO BE SAFETY WIRED TO DRILLED LOCK NUT AT INSTALLATION IN AIRCRAFT.

				LEAR, INC.	
			INSTALLATION DATA - JULIO I DRIVE ASSY.		3000-1



FOR MODEL 3000 C & D SERVO

INTERCONNECTING DIAGRAM ARCON 1A

NOTES:

1. FOR 14 V. SYSTEM, CONNECT AS SHOWN.
   FOR 28 V. SYSTEM, (A) DISCONNECT LEAD TBI-B TO PI-B, AT PI-B RECONNECT TO PI-J.
   (B) REMOVE JUMPER LEAD TBI-B TO TBI-X.
2. ALL CABLING #22 WIRE EXCEPT WHERE OTHERWISE SPECIFIED.
3. CONNECTION TO B&C OF P4 MAY BE REVERSED TO PROVIDE PROPER SENSING OF THE SYSTEM OF P4.
4. WIRE FROM TBI-N AND BONDING JUMPER FROM MODEL 3000 C & D ARE GROUNDED TO SHIP'S FRAME NEAR SERVO MOUNTING BRACKET.

F 9831	SEE E.C.O.
F 10356	SEE E.C.O.

702388 F

PART No.

LEAR, INCORPORATED

DIAGRAM-INTERCONNECTING ARCON MODEL 1A

D 702388

APPENDIX II

PARTS LISTS

AMPLIFIER PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 1-99	Amplifier (ARCON 1A) Model 2219A; 14 or 28v, chassis 702313, cover 702312, 9-3/4 x 4-1/2 x 4-1/8 (including shockmount) Model 2219C; 14 or 28v chassis 702847, cover 702848, 8-1/2 x 4-1/2 x 4 (including shockmount)	Converts gyro error output signals to DC servo operation signals	702338-01 702338-03	1
BR1	Rectifier, Bridge; cell rating 25v rms, 10 average ma per cell	Full wave rectification of T1 output at pin 5	702364	2
BR2	Same as BR1	Full wave rectification of T1 output at pin 4		-
C1	Capacitor, Fixed; Electrolytic; 5 mfd, 50v, temp range -55°C to +85°C	Filter for BR1	702360	4
C2	Same as C1	Filter for BR2		-
C3	Same as C1	Filter for D1 and D2		-
C4	Same as C1	Filter for D3 and D4		-
D1	Crystal Unit, Rectifying; Germanium Type; peak forward current 300 ma, peak inverse voltage 125v	Operates with D2 to give full wave rectification of T2 output	702356	4
D2	Same as D1	Same as D1		-
D3	Same as D1	Operates with D4 to give full wave rectification of T2 output		-
D4	Same as D1	Same as D3		-
E1	Card, Etched Circuit	Printed amplifier circuit	702210	1
P1	Connector, Plug; 15 Female Connection	Connects cable to end of printed amplifier circuit	702325	1
R1	Resistor, Fixed; Composition; 10 kilohm, 1/2W, ± 10%	Filter resistor for BR1	57088	2
R2	Resistor, Fixed; Composition; 1 kilohm, 1/2W, ± 10%	Current limiting for BR1	57076	2
R3	Same as R1	Filter resistor for BR2		-
R4	Same as R2	Current limiting for BR2		-
R5	Resistor, Fixed; Composition; selected value, 1/2W	Bias matching between T3 and T4		1 (optional)
R6	Resistor, Variable; Composition; 1 kilohm, 1/2W, ± 10%	Controls quiescent clutch current and varies bias on T3 and T4	702344-02	1
R7	Resistor, Variable; Composition; 25 kilohm, 1/3W, ± 10%	Rate gyro gain for T1	702344-01	1
R8	Resistor, Fixed; Composition; 180 ohm, 1/2W, ± 10%	Bias dropping for T3 and T4	57067	1

AMPLIFIER PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
R9	Resistor, Fixed; Composition; 330 ohm, 2W, ± 10%	Filter resistor for D3 and D4	57626	2
R10	Same as R9	Filter resistor for D1 and D2		-
R11	Not used			
R12	Resistor, Fixed; Composition; 220 ohm, 1/2W, ± 10%	Bias dropping for T3 and T4	57068	1
T1	Transformer, Discriminator	Compares reference voltage with rate gyro signal, or with turn and trim signals, and applies resultant signal to rectifier bridges BR1 and BR2	702335	1
T2	Transformer, Power	Furnishes power to servo clutches through magnetic amplifiers T3 and T4	702336	1
T3	Amplifier, Magnetic	Amplifies T2 output as BR1 current decreases	702337	2
T4	Same as T3	Amplifies T2 output as BR2 current decreases		-
TB1	Board, Terminal	Cable connection	702308	1

CONTROLLER PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 100-199	Controller (ARCON 1A) Model 5452A	Amplifier and motor-alternator power on-off; feeds turn and trim signals to amplifier discriminator transformer T1	702486-01	1
E101	Knob Assembly, Bar Set Screw Set Screw	Controls R102 Retains knob E101 Retains knob E101	702483 97519-02 97519-06	1 1 1
E102	Knob, Trim	Controls R101	702521	1
E103	Lub, Quick Disconnect	Cable connection	43770	6
E104	Lug, Quick Disconnect	Cable connection	43770-03	4
F101	Fuse 8 amp, 28v 15 amp, 14v	Power fuse 28v operation only 14v operation only		1
R101	Resistor, Variable; Composition; 250 ohm, 2W, ± 10%	Trim setting	63200-66	2
R102	Same as R101	Turn control		-

CONTROLLER PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
R103	Resistor, Fixed; Composition; 120 ohm, 1W, ± 10%	Limits current through R101 and R102	55662	1
S101	Switch, Toggle; SPST	Power on-off	43906-02	1

ENGAGE-DISENGAGE SWITCH PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
S201	Switch, Push-pull; SPDT	Amplifier power transformer T2 on-off	702830-02	1

GYRO BASE PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 300-399	Base, Rate Gyro	Mounts gyro	704759	1
R301	Resistor, Fixed; Wire Wound; 1250 ohm, 5W, ± 5%	Gyro motor shunt	703064-01	1
R302	Resistor, Fixed; Wire Wound; 8000 ohm, 5W, ± 5%	Gyro motor shunt	703064-02	1
XT301	Socket, Electron Tube; Miniature 9 Connection	Mates with gyro connector	702341	1

MOTOR-ALTERNATOR - SERVO PARTS LIST
MODELS 3000 A AND B

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 400-499	Motor and Alternator (ARCON 1A) Model CY-14C-1 (14v) Model CY-14B-1 (28v)	Drives capstan; generates 3Ø, 115v, 400 cps	 102550-01 102550-02	1
C401	Capacitor Assembly, Fixed; Paper Dielectric; 1 mfd, +30% - 10%, 50 - 100 WVDC	Prevent arcing at brushes	74271-01	1
E401	Brush	Motor brush	85938	2
E402	Cap, Brush Holder	Holds brush	39390-07	2
J401	Connector, Receptacle; 5 Male Connection	Mates with P401	AN3102A-14S-5P	1

MOTOR-ALTERNATOR - SERVO PARTS LIST (cont)
MODELS 3000 A AND B

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
P401	Connector, Plug; 5 Female Connection	Mates with J401	AN3106B-14S-5S	1
Servo Assy	Servo Parts are listed in figure 3-6			

MOTOR-ALTERNATOR - SERVO PARTS LIST
MODELS
3000 C AND D
3000 C1 AND D1
3000 C2 AND D2

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 400-499	Motor and Alternator (ARCON 1A) Model CY-14E-1 (28v) Model CY-14F-1 (14v)	Drives capstan; generates 3Ø, 115v, 400 cps	 108200-01 108200-02	1
C401	Filter Assembly	Prevents arcing at brushes	107994	1
E401	Brush	Motor brush	107603-01	2
E402	Cap, Brush Holder	Holds brush	39390-07	2
E403	Terminal Lug	Grounding lug	AN659-2	1
E404	Terminal Lug	Grounding lug	AN659-5	2
E405	Lug, Quick Disconnect	Cable connection	77783-01	6
Servo Assy	Servo Parts are listed in figure 3-6			

GYRO SUBSTITUTION TEST SET PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 1-99	Test Set, Gyro Substitution (ARCON 1A) Model 2244A	Simulates gyro signals and gyro motor	702410	1
E1	Knob	Controls R1	702438-01	1
J1	Connector, Receptacle; Miniature 9 Male Connection	Substitutes for gyro receptacle	702496-01	1
PL1	Lamp, Neon; voltage range 105-124 VAC, 1/25W, bulb size T 3-1/4, miniature bayonet base	Phase A indicator lamp	702460-01	2
PL2	Same as PL1	Phase B indicator lamp		-

GYRO SUBSTITUTION TEST SET PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
R1	Resistor, Variable; Composition; 5 kilohm, 2W, ± 10%	T1 output phase shifter	63200-64	1
R2	Resistor, Fixed; Wire Wound; 2 kilohm, 10W, ± 10%	PL1 shunt	702557-02	3
R3	Same as R2	PL2 shunt		-
R4	Same as R2	Phase C to B shunt		-
T1	Transformer, Discriminator	Simulates gyro output	702335	1
W1	Cable Assembly, Gyro Substitution Test Set	Connects with gyro cable	702448	1
XT1	Socket, Electron Tube; Miniature 9 Connection	Transformer T1 socket	62234-05	1

ARCON TEST SET PARTS LIST

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
Series 100-199	ARCON Test Set (ARCON 1A) Model 2243A	Tests motor-alternator, amplifier and clutch operation	702350	1
E101	Terminal Lug	Meter connection	4156	6
M101	Meter	Right clutch current meter	702326-02	2
M102	Same as M101	Left clutch current meter		-
M103	Meter	Power and alternator voltmeter	702326-01	1
P101	Connector, Plug; 15 Female Connection	Connects test set to amplifier	702325	1
P102	Card, Test; Etched Circuit	Simulates connector end of amplifier printed circuit	702218	1
R101	Resistor, Fixed; Wire Wound; 47 ohm, 2W, ± 1%	Dummy load	702969	2
R102	Same as R101	Same as R101		-
R103	Resistor, Fixed; Composition; 30 kilohm, 1/2W, ± 1%	Current limiting for M103	97379-09	1
R104	Resistor, Fixed; Composition; 4.7 kilohm, 1/2W, ± 5%	Prevents shorting of M103	56964	1
R105	Resistor, Variable; Composition; 15 kilohm, 1/4W, ± 10%	Current limiting for M103 and Y101	63200-63	1
R106	Resistor, Fixed; Composition; 100 kilohm, 1/2W, ± 10%	Same as R105	57100	1
S101	Switch, Toggle; DPDT	Dummy-clutch switch	90698	1

ARCON TEST SET PARTS LIST (cont)

Symbol Number	Description	Function	Lear Part Number	Qty per Equipment
S102	Switch, Rotary; 3 Wafer Section	Test circuit selector	97327-04	1
TB101	Board, Terminal	Circuit wiring	702345	1
W101	Cable Assembly	Connects to amplifier cable	702361	1
W102	Chassis Assembly, Test	Connects cable assembly to amplifier base	702320	1
Y101	Rectifier, Bridge, Copper Oxide Type; 15 ma peak forward current, 30v peak voltage	Rectify A, B, and CØ	702378	1

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